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CONTINUITY IN AGRICULTURAL MATTERS.

Not only is contiguity required in dealing with agriculturists, but also *continuity*, and this is one of the weak points in the present organisation of the island from an agricultural point of view. If a given improvement is to be introduced into a certain district, not only must it be demonstrated near to the people, but it must be continuously demonstrated. If it is demonstrated in one season to be a success, and then taken away, the man who sees it will say that it was removed because one was afraid (or certain) that it would not succeed twice running. Successful results must be shown for at least four or five seasons running before people can be expected to imitate them, other than perhaps one or two of the most intelligent agriculturists.

For this reason it is important to try doubtful experiments only in Experiment Stations—and to some extent in school gardens—and to demonstrate to the people, on the spot, only those which are unquestioned successes. If, for example, there be any doubt whether a new variety of some local crop be a success, it can easily be tried all over the island by being distributed to the school gardens, and then demonstrated to the people in those districts where it succeeds.

In the same way, agricultural shows, as we have already pointed out, should be continuous in any district where they are started, or the good they do is merely evanescent. Whereas, if they be continuous, some good may be expected to follow after they have been held four or five times in the same place.

But this is a topic on which one might write for long, and we aim always at keeping leaders short.

GUMS, RESINS, SAPS AND EXUDATIONS.

MANURING OF HEVEA RUBBER.

(From *Tropical Life*, Vol. VII., No. 5, May, 1911.)

Although the application of manures is a comparatively recent introduction into rubber plantations, experiments have already shown that their judicious use is followed by good results and improved yields. It has been established that when the soil is supplied with a well-balanced plant-food the growth and the vigour of the rubber trees are considerably increased, rendering them at the same time more capable of resisting pests and injuries from other causes. Properly manured young trees allow tapping operations to be commenced six to twelve months earlier, whilst similarly treated old trees show a greater increase in girth and renew their bark more quickly and more thoroughly than the trees grown on unmanured land. Experiments have further shown that owing to the application of manures the flow of latex was more vigorous, and that the coagulation of rubber from this latex took place more promptly. If, on the other hand, it is borne in mind that the fertility of the soil of a plantation is reduced not only by the amount of plant-food removed in the latex, but to a much larger extent by the considerable quantities of fertilizing ingredients which are continuously required for the renovation of the bark, for the growth of new wood, and for the production of leaves and fruit, it is obvious that sooner or later even the richest soil becomes exhausted unless adequately manured. It therefore follows, in the light of the above results, that it is to the advantage of every planter to prevent soil-exhaustion on his plantation, and at the same time to encourage increased yields of rubber.

Unfortunately, on nearly every plantation the production of farmyard manure and compost, even if all the waste is clearly collected, is insufficient to meet the manurial requirements of the plantation. Therefore, in order to maintain or to increase the fertility of the soil, the bulk of, if not all, planters must avail themselves of the use of artificial manures, especially as they can be made up to any formula, and so enable the owner or manager to apply just those fertilizing ingredients that are needed.

Nitrogen in readily available form is supplied by nitrate of soda, nitrate of potash, nitrate of lime, sulphate of ammonia and calcium cyanamide or nitrolim. Nitrate of soda, nitrate of potash, and nitrate of lime contain nitrogen in the form of nitric acid—which is directly assimilable by the plants—dissolve easily in water, and are not absorbed by the soil. They should therefore be applied in light dressings only, in order to prevent their being washed out of the soil. Nitrate of soda contains 15·5 per cent. and nitrate of lime 13·9 per cent. nitrogen. Nitrate of potash contains 13·5 per cent. nitrogen and 44 per cent. potash, and should—owing to this high percentage of potash—only be used on soils which are deficient in potash. Sulphate of ammonia and calcium cyanamide contain 20 per cent. and 18 per cent. nitrogen respectively, but in such a form that they must undergo a change into nitric acid in the soil before they become an available plant food. In the Tropics, however, this change takes place very speedily, so that there is scarcely any difference between the effectiveness, nitrogen for nitrogen, of nitrate of soda, nitrate of lime, sulphate of ammonia, and calcium cyanamide. The choice between these is dictated more by the character of the soil and the price of the fertilizers per unit of nitrogen. Whereas calcium cyanamide and nitrate of lime are suitable for all soils, though preferable for those poor in lime, sulphate of ammonia should only be used on soil well provided with lime. Nitrate of soda can be profitably used on almost all soils, excepting light sandy soils, but shows its best effects on loamy soils.

All these nitrogenous manures are quick acting, and their nitrogen will be absorbed by the rubber tree within a short time* of their application. It will therefore be advisable to meet the continuous requirements of the rubber tree in nitrogen by applying a portion of what is required by means of some less quickly available manure, such as oil cake or blood meal.

The best-known phosphatic manures are super-phosphates and Thomas' phosphate powder or basic slag.

The manurial value of the superphosphates (ordinary and concentrated) depends upon their content of phosphoric acid soluble in water and in citrate of ammonia solution. Whereas the percent-

* The effect of an application of nitrate of soda upon the flow of latex in Ceara trees was manifested within 48 hours. (See Hawaii Bulletin, No. 16.)

age of water-soluble phosphoric acid ranges from 12 to 20 per cent. in ordinary superphosphates, the concentrated superphosphates contain 40 to 43 per cent. water-soluble phosphoric acid, and 2 to 3 per cent. phosphoric acid soluble in citrate of ammonia solution.

If superphosphate is applied to the soil, its phosphoric acid, being soluble in water, becomes disseminated throughout the soil, and is there absorbed by other soil constituents, as lime, magnesia, iron, and alumina, forming phosphates which are insoluble in water. In soils containing a fair amount of lime the water-soluble phosphoric acid is precipitated into phosphate of lime, which supplies the plants with available phosphoric acid; but on soils poor in lime, the water-soluble phosphoric acid is either subject to being washed out of the surface soil, or is absorbed by the oxides of iron and alumina forming compounds, the phosphoric acid of which the plants can only assimilate with the greatest difficulty. The use of superphosphates should therefore be limited to soils which are not deficient in lime; on these, 1 lb. of phosphoric acid in ordinary superphosphates has the same effect as 1 lb. of phosphoric acid in concentrated superphosphate.

Thomas' phosphate powder, a by-product in the manufacture of steel free from phosphorus, contains 15 to 20 per cent. phosphoric acid, 40 to 50 per cent. lime, and 4 to 5 per cent. magnesia. The phosphoric acid in Thomas' phosphate powder, although insoluble in water, is easily soluble in weak acids, and therefore readily assimilated by plants. In genuine Thomas' phosphate powder 80 per cent. and more of its phosphoric acid is soluble in a 2 per cent. citric acid solution, which portion is considered quite as available as the water-soluble phosphoric acid in super-phosphate. As the phosphoric acid in Thomas' phosphate powder does not undergo any changes in the soil which might reduce its availability, the use of this phosphatic fertilizer is not restricted to any particular class of soil, but can be applied with advantage to all soils. Its effects are most marked on soils deficient in lime, and on soil containing an excessive quantity of organic matter, in which cases the effects of the Thomas' phosphate powder are due not only to the phosphoric acid but also to the lime it contains. The latter can be easily assimilated by plants, and, like every other form of alkaline lime, improves the mechanical condition of the soil, promotes the oxidation of the nitrogenous reserves, brings the soil potash in solution, and helps to neutralize and render harmless the organic acids of soils rich in humus.

The principal potash manures in use are sulphate of potash and muriate of potash. The former, containing 48 to 52 per cent. potash is especially recommended for soils deficient in lime, whereas the use of muriate of potash, containing 50 to 59 per cent. potash is better limited to soils containing an ample supply of lime. The sulphate of potash, being less soluble than the muriate of potash, is better retained by the soil, and in very wet districts, although a little dearer, is a more profitable source of potash than muriate of potash.

If the soil of the plantation is so poor in lime that this deficiency cannot be made good by the continued use of Thomas' phosphate powder as phosphatic manure, the application of burnt lime or ground lime-stone becomes necessary.

As to the quantities of fertilizing ingredients to be applied to rubber plantations, this depends not only upon the different requirements of the rubber trees at their various ages, but also upon the condition of the soil. For plantations on fair average soils, showing neither a marked excess nor a marked deficiency in either of the three fertilizing ingredients—nitrogen, phosphoric acid, and potash—the supply of plant-food may be considered as well balanced if these fertilizing ingredients are applied in the proportion of 1 part nitrogen, 1 to 1·5 parts phosphoric acid, and 1·5 to 2 parts potash; and, therefore, for trees old enough to be tapped, which require about 40 lb. nitrogen, 60 lb. phosphoric acid, and 70 lb. potash per acre, the following mixture may be safely recommended to ensure good results:—

1½ cwt. nitrate of soda (or 1⅛ cwt. sulphate of ammonia).

1½ cwt. oil cake.

3½ cwt. Thomas' phosphate powder (or 1½ cwt. concentrated superphosphate).

1¼ cwt. muriate of potash.

All these manures may be mixed together, with the exception of Thomas' phosphate powder and sulphate of ammonia.

Where, however, plantations are laid out on poor soils, the above quantities should be increased by one-half; and a similar increase is advisable as regards the potash supply on light soils, whereas on strong soils—which are, as a rule,

poor in phosphoric acid and lime—5 cwt. Thomas' phosphate powder per acre will meet the requirements of the rubber tree better than either of the phosphatic dressings suggested above. Furthermore, if the trees show a good leaf growth, the nitrogenous dressing may be decreased by one-third, whereas if the leaf growth is weakly, better results will be obtained by increasing the nitrogen supply one-third.

As to the manuring of young plantations, the planter will be well advised to make use of the nitrogen collecting power of leguminous plants, which, grown between the rows, and forked in when they are in flower, are able to meet the young rubber trees' requirements of nitrogen. In order to enable the leguminous plants to develop vigorously, and to accumulate an increased quantity of nitrogen, it is, of course, necessary to manure same with phosphoric acid and potash, say 2 to 3 cwt. Thomas' phosphate powder and ½ to ¾ cwt. muriate of potash per acre. Such "green manuring" may be practised as long as the growth of the leguminous plants does not hinder the roots of the rubber trees in their proper development.

When, however, green manuring is not adopted, the nitrogen has to be applied by means of artificial manures. Young trees should receive, during the first year, a manuring with ⅜ oz. of nitrate of soda, ⅜ oz. oil cake, 1¼ oz. Thomas' phosphate powder, or ½ oz. concentrated superphosphate, and ⅜ oz. muriate of potash per tree, these quantities to be doubled from year to year till the trees are fit for tapping, when the full manuring suggested above may be adopted annually.

The artificial manures are to be sprinkled around the trees. Until the young trees reach their fifth or sixth year, it is a better practice to manure them singly, by distributing and forking in the manures around the stem at a distance of from 1 to 1¼ ft. for each year of the tree's growth. After the sixth year the soil of a plantation is so thoroughly permeated by the roots of the trees that the artificial manures can be distributed over the whole plantation.

CASTILLOA ELASTICA: TAPPING AND YIELDS.

By Frank Evans,
Botanic Department, Trinidad, B.W.I.

(From *Tropical Life*, Vol. VII., May, 1911, No. 5.)

There appears to be great diversity of opinion, both as to the best method of tapping, and the yield obtainable from the Central American rubber tree (*Castilloa elastica*).

Latest returns show very clearly that estimates of yields made in former years were far too high.

Cross, in 1881, estimated the annual yield of dry rubber at 12 lb. per tree; another writer stated that the average annual yield of trees in Nicaragua, when tapped spirally, was 10 lb. per tree.

In 1903 and 1904, trees in the Dominica Botanic Gardens gave an average of 1 lb. per tree. The tapping in 1903 was by means of slits cut with an ordinary knife, and in 1904 with a tool used in the East for tapping Hevea. The Dominica experiments of 1905 conducted with a view of ascertaining the best method of tapping, favoured oblique lines cut about 18 in. apart on one-half of the circumference of the tree; this agrees with the results of Trinidad experiments.

In 1908, when the writer carried out trial tappings on plantations in the Naparima district of Trinidad, good results were obtained with oblique cuts made with an Hevea tapping knife, also with incisions made with an ordinary 2 in. chisel driven in with a mallet. When using mallet and chisel, care should be taken to drive in the chisel at one level, as an upward or downward cut is apt to split the bark. In 1910, experiments with pricking instruments were made at the Trinidad Experiment Station, the idea being to puncture the whole surface of the trunks to a height of 8 to 10 ft. from the ground. Preliminary tests gave promising results, small punctured areas giving yields amounting to ¾ to 2¾ lb. dry rubber per tree at one tapping. The chief drawback to the use of pricking instruments is the difficulty of making clean cuts, the wounds usually being rough-edged and heal badly. Another objection is the amount of labour required to continually force in the prickers; but this difficulty could probably be overcome by the use of a portable engine, worked by compressed air, and connecting by tubing with the tapping tool. The apparatus must be light enough to be carried and guided

by one man. This may seem impossible or difficult, but many agree that tapping operations of the future will be conducted with the aid of steam, electric, or other power. Experiments in Tobago show that eight to ten-year-old trees tapped with mallet and chisel will give an average annual return of 3 to 4 oz. of dry rubber per tree. A few trees give 1 to 1½ lb. On one plantation it is recorded that some years ago a few hundred ten-year-old trees gave ½ to ¾ lb. per tree.

In 1905, experimental tapping with V-shaped cut on a few thirteen-year-old trees in the St. Lucia Botanic Gardens, resulted in an average return of 11·16 oz. per tree. This yield is similar to that obtained the same year in the vicinity of Bluefields, Nicaragua, where 6,000 trees gave an average of 11·3 oz. dry rubber per tree. Results in Ceylon appear to be less favourable, as, according to the published minutes of the Experimental Station Committee, a tree at Peradeniya, tapped to a height of about 18 ft., gave only 50·90 grammes of dry rubber, although the method of tapping was the full herring-bone on each side, inflicted with mallet and chisel.

Reports from Mexico show the yields in that country vary from 3 to 12 oz., according to the age of the trees. The tapping method in most general use is the long V-shaped cut; but as the apex of the V does not heal well, this system of tapping leaves much to be desired, and is being discarded by the more advanced Mexican rubber planters. Dr. Olsson-Seffer, who has made an exhaustive study of the Castilloa tree, recommends the half-herring bone system of tapping, which consists of a longitudinal channel into which oblique cuts lead from one side only, and so, whilst the full area to be tapped is covered, the tree suffers less than by the V cuts.

NEW USES FOR RUBBER.

Constantly being Devised—Additional Uses through Recent Discoveries besides those formerly Published.

(From the *Manila Bulletin*, June 7, 1911.)

Only recently the Bulletin gave an article on some of the new uses for rubber, and the fact that with the present production it would be impossible to overstock the market as the demand was rapidly increasing, in fact keeping ahead of the supply.

Some additional uses for rubber are here given, new uses being constantly devised, which must result in increasing to some extent its consumption. Some of the more recent new uses are sufficiently unique to be interesting and afford an insight into the diversified utility of this remarkable material.

The following on the new uses and recent discoveries is taken from The *India Rubber World* :—

One of the most remarkable, and at the same time, one of the most beneficent uses suggested for rubber, is for the construction of artificial or supplementary muscles for children suffering or threatened with infantile paralysis. By the local application of strips of elastic rubber over the weakened muscles, in a manner devised and described by Dr. Roland O. Meisenbach, Buffalo, N. Y., the tensile strength the muscle lacks is supplied, a local stimulus effected and contractions prevented, while the application being painless and not inconvenient, and the effect being continuous and independent of the patient's volition, the remedy is especially applicable for children.

Carpet sweepers are equipped by a manufacturer with corner buffers, by means of which the furniture is protected from injury, and they can be applied to either new or old sweepers. Another manufacturer employs rubber in the manufacture of a pad that protects table tops from defacement by hot dishes.

In the future development of the flying machine, rubber seems destined to prove an important factor. Rubberized fabric for planes has been given the preference by the most successful practical aviators, while the extent to which a safe and successful landing depends on the quality of the rubber tyres with which the "plane" is equipped, has induced leading tyre manufacturers to bestow particular attention on the production of "aeroplane tyres."

In the form of hose, rubber comes into use in an ingenious machine, employed by paviors in Germany, for ramming or tamping paving blocks into place. The pneumatic ramming tool is connected by rubber hose with a portable air compressing plant, and the compressed air, acting on its mechanism, causes it to deliver a rapid series of hard blows on the paving stones that are being set.

Another use to which rubber hose is put is in the operation of an ingenious vacuum cleaner, for which a stream of water from an ordinary faucet furnishes the power. Passing down one arm of a

Y branch, it creates, by suction, a partial vacuum in the other arm, and this in turn is connected with the cleaning tool. The dust laden air draws up the tube, encounters the water at the junction of the Y, and the dirt is washed down the drain. Rubber tips for furniture, rubber tiling for floors, rubber trays and dishes are made for photographers, while rubberized cotton fabric for balloons is much less expensive, lighter and more impenetrable than the water-proofed silk heretofore used. In addition to its extensive employment in tyres, rubber has found very many uses in connection with the automobile, mats for the floors, pads for the pedals, hand grips for the levers, all are made of rubber, and to some extent it enters into shock absorbers and similar devices, to say nothing of the tubing for gas lamps, electrical insulation, hose connections for radiators, etc. It would be possible to enumerate a thousand and one purposes for which rubber in various forms is employed, that have been added within the past few years to its uses. It is a question whether, with all the additions that have been made to the output within the past few years, in the shape of plantation production, reclaimed rubber, etc., the "new uses" have not more than made up for the increase in production, so that, as far as the volume at the disposal of the consumers is concerned, there is but little improvement to be recorded.

OILS AND FATS.

HYDNOCARPUS VENENATA, GAERTN.

THE SOURCE OF THE POISONOUS CARDAMOM-FAT USED IN THE MARGARINE "BACKA."

(BY A VOIGT in *Jahresb. d. Verein. für angew. Botanik*, p. 171, 8, 1911.)

[Abstracted by J. C. WILLIS.]

In November and December, 1910, many people in the large German towns were made ill by a margarine called Backa, Investigation showed that a fat had been obtained from England under the name "Cardamom-fat," known also as Maratti-fat.

Some seeds were obtained and proved to be those of *Hydnocarpus venenata* (Makulu, Singh., Makal, Tam.) a common tree in the lowcountry of Ceylon. The fruits are used here as a fish poison, having narcotic properties, and the oil from the seeds is used in skin complaints.

Enquiry showed that these seeds are known in England as "false Cardamoms," and are used to adulterate the true Cardamoms, with which they have much likeness.

FIBRES.

INDIA AND PAPER-MAKING.

(From the *Indian Agriculturist*, Vol. XXXVI., No. 2. February 1, 1911.)

Mr. William Raitt, an authority on paper fibre, read a paper at the Allahabad Industrial Conference in which he makes out a good case for thinking that a liberal reward awaits those capitalists who take up in earnest the manufacture of paper-pulp in this country. The present position of India in regard to the production and consumption of paper is not much to its credit. Mr. Raitt estimates the consumption at 40,000 tons a year, as against a consumption of a million tons in the United Kingdom. This limited demand is perhaps not to be wondered at when it is considered that the vast bulk of the people are illiterate, and have, therefore, no use for books. magazines or newspapers. But it is at first sight surprising that a half even of the small amount of paper consumed in India is imported from Europe, and that a country which abounds in the raw materials of the paper industry should be dependent on foreign countries whose supplies of raw material are steadily and rapidly diminishing. The explanation which Mr. Raitt offers of these puzzling facts is very simple. The essential condition which the manufacturer of paper must satisfy is cheapness. Hence he has in every age used materials rejected by other crafts. When rags were worthless, before the days of shoddy, he used rags. A rise in the price of rags drove

him to employ Esparto grass, and, when his supplies of this material ran short, he resorted to pulp made of trees which were of little value for any other purpose. It may be asked why at this stage in the industry India has not developed into a great paper-making country. The reason is not very evident. A demand for wood-pulp has already arisen in India. Owing to the fact that the grasses used in paper-making yield a considerable percentage of waste, the cost of carriage becomes an important factor. Mr. Raitt states that 2½ tons of Bhabar and Munj grasses are required to produce a ton of paper. Consequently, when the local supply became exhausted, a point was soon reached when railway rates made profitable manufacture impossible, and, indigenous wood-pulp not being available, Indian mills have been driven to import wood-pulp to eke out their local resources. The cheapness of foreign wood-pulp is accounted for partly by the abundance of timber of the kind required, and partly by the enterprise and business acumen which have led its manufacturers to locate their factories in the immediate vicinity of the forests, so that the waste portion of the wood is eliminated on the spot, and only the actual paper-making pulp is sent by ship or rail. It is the adoption of this mode of economising in freight charges which is required in India. "The Indian paper trade," says Mr. Raitt, "has shown no want of enterprise in the past, and the best proof of that is in the fact that it has now expanded up to the full economic limits of its present raw material supply. Provide new sources of that, and the paper-maker will do the rest. In suitable localities erect pulping mills to reduce the local raw material to half-stuff, eliminating on the spot the 60 per cent. of waste and reducing the freight and handling charges in the proportion of 2½ to 1. Briefly and simply, in that lies the future of the Indian paper industry." And the sooner the enterprise is taken in hand the better. The recent rise in the price of both pulp and paper points to the diminishing supply and increasing dearness of the timber resources on which Europe has hitherto relied. The wonder is that the enormous consumption has not told earlier upon prices. According to Mr, Raitt, a London daily paper devours in a year the arboreal produce of 5,000 acres, with the result that "whole districts once clothed with virgin forest—nay whole provinces—have gone galloping down the ever-open maw of a hungry press until now a condition of things has been reached in which the pulp-wood resources of the United States of America are admittedly exhausted and those of Europe considerably curtailed." India has, in these circumstances, a splendid opportunity. Happily this country is rich not only in spruce and fir, which offer only a limited supply, but also in the bamboo which is, as Mr. Raitt says, literally inexhaustible. A mill erected in a suitable locality for pulping bamboos will never be rendered useless by the disappearance of its raw material. It can easily perpetuate its supplies. On this ground alone Mr. Raitt is, it seems to us, justified in predicting that bamboo pulp will ultimately become the leading staple of the paper industry. It is strange how long it has had to wait for recognition. More than thirty years ago Mr. Thomas Routledge wrote his pamphlets on the merits of bamboo as a paper-making material, but only as recently as 1905 was the importance realised of ascertaining by skilled investigation the practical possibilities of this giant grass, which flourishes over huge areas in India. In that year the Indian Government requested Mr. R. W. Sindall, a London Paper expert, to visit Burma and report on the feasibility of using bamboo for the manufacture of paper. The conclusions at which he arrived were favourable, and have since been confirmed by the actual conversion of bamboo into paper. The experiment was carried out by Messrs. Thomas and Green, of the Soho Mills, Wooburn Green, who were agreeably impressed with the admirable qualities of bamboo paper, its strength, and the suitability of its surface for both letter-press and lithographic work. Unfortunately the conditions on which the Government of Burma were prepared to make concessions to the pioneers of a new industry were too onerous, and nothing has been done, so far as we know, to put Mr. Sindall's calculations to a test on a commercial scale. Possibly Mr. Raitt's paper may rouse new interest in a promising industry which has all the essentials of success.

DRUGS AND MEDICINAL PLANTS.

PRODUCTION AND USE OF COCA LEAVES.

(From the *Bulletin of the Imperial Institute*, Vol, VIII., No. 4, 1910.)

Coca leaves are derived from a plant, *Erythroxylon Coca*, which occurs native in the countries along the Western Coast of South America, and especially in Peru and Bolivia. In recent years coca plantations have been formed in Java and Ceylon, and considerable supplies are now derived from these latter countries, but especially from Java. The drug is the source of the alkaloid cocaine, which is very largely employed in medicine as a local anaesthetic.

Attention has been particularly directed in recent years to the trade in coca leaves and in the alkaloid cocaine prepared from them owing to the fact that this alkaloid has been used by natives, especially in Far Eastern countries, as an intoxicant, with the result that restrictive legislation has had to be introducêd in India, the Straits Settlements, and elsewhere to prevent the spread of this "cocaine habit."

From a commercial point of view special interest attaches to the drug from the fact that an understanding is stated to have existed until recently among the comparatively few manufacturers of cocaine, whereby the prices paid by them for their raw material—coca leaves—have been kept at a low level, whilst prices for the pure alkaloid have been raised. Owing to the diminution in output from Peru, Java has acquired a predominant position in the production of coca leaves, and a proposal has been made there recently that planters in Java should take advantage of this state of things to establish a practical monopoly in this industry. As the cultivation of coca leaves is already well established in Ceylon, and may be taken up in other British colonies, it becomes of interest to summarise the position of this industry at the present time.

The commercial supply of coca leaves is almost entirely derived from Peru, Java, and Ceylon. Coca is produced in Bolivia, Brazil, and other parts of South America, but only very small quantities are exported from these countries. Experimental cultivation of the leaves has been undertaken in India, the United States, the Federated Malay States and elsewhere, but at present there appears to be no production on a commercial scale in these countries.

From Peru, both coca leaves and cocaine are exported. The cocaine produced is crude and impure, and is mostly exported to Germany, where it is refined. From Java, coca leaves only are exported at present, though it has been proposed to open a factory there for the manufacture of cocaine. The coca leaves exported from Java are stated to contain little or no cocaine, but they are rich in other alkaloids from which cocaine can be made by a comparatively simple process. All the Java coca leaves are at present said to be worked up in Holland and Germany for the manufacture of cocaine.

The statistics of export of coca leaves and cocaine from Peru and of coca leaves from Java and Ceylon, so far as they are obtainable, are given below :

EXPORTS OF CRUDE COCAINE FROM PERU.

Year.	To Germany.		To United Kingdom.		To United States.	
	Quantity Kilos.	Value £.	Quantity Kilos.	Value £.	Quantity Kilos.	Value £.
1903 ...	6,770	84,626	553	6,912	58	725
1904 ...	6,156	76,961	959	11,987	284	3,550
1905 ...	6,133	108,600	300	5,684	134	2,304
1906 ...	5,184	69,862	424	5,532	...	...

Year.	To France.		Total.	
	Quantity Kilos.	Value £.	Quantity Kilos.	Value £.
1903 ...	414	5,180	7,800	97,506
1904 ...	128	1,600	7,527	94,099
1905 ..	...	...	6,778	116,590
1906 ...	305	3,676	5,914	79,071

For the above figures the Imperial Institute is indebted to the Consul-General for Peru in London. According to information supplied by the Secretary to the British Legation at Lima, the total exports of cocaine from Peru amounted to 6,057 kilograms, valued at £66,630 in 1907. According to the *Boletin de Ministerio de Fomento*, published at *Lima*, the exports of coca leaves from Peru in 1905 amounted to 1,315,825 kilos, valued at £94,956, and in 1906 to 2,842,916 kilos, worth £130,325, but these figures are believed to be merely approximations. Later data are not obtainable.

The Consul-General for Bolivia, in London states that the total production of coca leaves per annum, in that country, is about 95,000 cwt., but of this only a very small amount is exported.

EXPORTS OF COCA LEAVES FROM JAVA.

1904.	1905.	1906.	1907.	1908.
lb.	lb.	lb	lb.	lb.
57,032	151,057	274,259	533,765	1,026,022

The above figures were compiled for the Imperial Institute from Batavia market reports, by His Majesty's Consul at Batavia. According to the Consul-General for Holland, in London, the total exports from Java and Madura in 1908 were 416,612 kilograms, valued at 166,645 florins, and of this quantity 311,292 kilos went to Holland, 102,320 kilos to Germany, and 3,000 kilos to the United Kingdom.

No cocaine is at present produced in Java.

EXPORTS OF COCA LEAVES FROM CEYLON.*

Year.	To United Kingdom. Quantity. lb.	To United Kingdom. Value. £†.	To Germany. Quantity. lb.	To Germany. Value. £.	To Belgium. Quantity. lb.	To Belgium. Value. £.
1906 ...	38,301	1,534	1,182	57	1,136	38
1907 ...	28,542	757	1,438	19	—	—
1908 ...	33,833	896	2,668	36	—	—
1909 ...	30,207	820	1,649	242	22,585	422

Year.	To Holland. Quantity lb.	To Holland. Value. £.	To Switzerland. Quantity lb.	To Switzerland. Value. £.	Total. Quantity lb.	Total. Value. £.
1906 ...	—	—	—	—	41,724	1,669
1907 ...	4,239	148	11,736	389	46,986	1,348
1908 ...	3,146	36	40,281	1,343	80,088	2,315
1909 ...	—	—	13,809	455	68,306	1,940

The Trade Returns of the United Kingdom do not show imports of coca leaves or cocaine under these headings, but the following figures of imports to the United States and to Hamburg afford some indication of the course of trade in these products.

IMPORTS OF COCA LEAVES TO UNITED STATES.

	Quantity. lb.	Value. Dollars.
1904-5	—	342,518
1905-6	2,650,141	488,545
1906-7	1,515,616	212,424
1907-8	633,121	76,109

IMPORTS OF MEDICATED LEAVES‡ TO HAMBURG FROM PERU.

	Kilos.
1905	618,600
1906	587,400
1907	354,800

If the export of coca leaves from Peru may be taken as about 1,000 metric tons per annum, and the exports of cocaine from the same country as about 6,000 kilos, then, taking the Java output of coca leaves at the figure for 1908, viz., about 1,000,000 lb., the maximum possible production of cocaine per annum would be from 18,000 to 20,000 kilograms

* From a Return supplied by the Principal Collector of Customs, Colombo.

† The original figures are in rupees; these have been converted at the rate Rs. 15=£1.

‡ Probably mainly coca leaves; the figures given for 1906 is quoted in the Hamburg Trade Returns as for coca leaves.

(39,000 to 44,000); but this is little more than a guess at the actual production, since a large proportion of the coca leaves which appear in commerce is no doubt used in the preparation of such products as "coca wine," liquid extract of coca leaves," etc., and is not employed for the production of cocaine. In this connection it is of interest to note that de Jong, in a recent number of *Teysmannia* (1910, p. 201), estimates the world's consumption of cocaine at 12,000 kilograms per annum, and points out that since the yield of dry coca leaf in Java is about 286 kilograms per acre, and as this is equivalent to 6 kilograms of pure cocaine, the area under coca can be extended to about 3,500 acres in Java before the present world's consumption of cocaine is reached, assuming that export of coca leaves from Peru can be suppressed as the result of the competition of the Java product. He recommends as the most economical plan the cultivation of coca as a catch crop in Para rubber plantations, so that a return may be secured in the first six years before the Para rubber trees are old enough to be tapped. In order that the Java planters may further secure their position, he recommends that they should combine to erect a co-operative central factory for the extraction of cocaine, so that they may be independent of cocaine manufacturers in Europe. Manufacturers of cocaine in Germany, who have been consulted on the feasibility of this project, state that there would probably be a saving of from 10 to 20 shillings per 100 kilogram of leaves worked as the result of extraction in Java instead of in Europe, and they express their willingness to take a share in the erection and working of the proposed Java factory.

At first sight this suggested extension of the Java industry in coca leaves seems to offer a prospect of serious competition with the Ceylon production of this drug, but it must be remembered, in this connection, that the variety of coca leaf cultivated in Java is only suitable for the manufacture of cocaine, since it is stated not to actually contain this alkaloid, but only alkaloids nearly related to it, and which after extraction are readily convertible by chemical means into cocaine. The coca grown in Ceylon, on the contrary, appears to be of the Bolivian variety, and should therefore be available, not only for the manufacture of cocaine, but also for the production of galenical preparations of coca, the form in which the drug is usually prescribed for internal use. For this purpose carefully prepared coca leaves of high quality are required, and consequently the Ceylon coca leaves, which answer these requirements and usually fetch the highest prices obtainable for this product, should be able to retain their present commanding position so far as this particular outlet is concerned. A complete investigation of Ceylon coca leaves is now in progress at the Imperial Institute with a view to determining definitely the nature of the alkaloids present, and especially the proportion of cocaine.

EDIBLE PRODUCTS.

NOTES ON GROUND-NUTS IN THE WEST INDIES.

(From the *West Indian Bulletin*, Vol. XI., No. 3, 1911.)

The following paper is intended as a summary of the results that have been obtained up to the present in the experiments on the cultivation of imported varieties of ground-nuts. These have been conducted at various Botanic and Experiment Stations in the West Indian islands during the last few years. An account of them is given in the Annual Reports of the Botanic Stations from the year 1907 onwards. In addition to the results thus obtained, various points in connection with these plants have also been included, in order to make the information presented as complete as possible. An earlier paper on this plant, by Freeman, containing a summary of the position of the industry in the West Indian islands before the introduction of the new varieties will be found in the *West Indian Bulletin*, Vol. IV., p. 101. Various articles have also appeared on this subject in the *Agricultural News*; references to these are given at the end of this paper.

In the year 1907-8, two American varieties of ground-nuts, Dixie Giant and Tennessee Red, were imported by the Imperial Commissioner of Agriculture, and distributed for trial at the Botanic and Experiment Stations in St. Vincent, St. Lucia, Dominica, Montserrat, Antigua and St. Kitts-Nevis. In the subsequent year two other varieties, Spanish and Carolina Running, were imported

from the United States and grown in the same islands. The results obtained were, on the whole, disappointing, with the exception of the yields given by the varieties grown in Dominica. This was to some extent due to poor germination, in the case of the Dixie Giant variety, and in that of the other varieties to the attacks of fungi. These consisted of a rust fungus on the leaves, reported as *Uromyces* sp. and *Uredo* sp., and a sterile root fungus which has since been found on several host plants, but has not so far been known to form any kind of fructification.

In the year 1909 the trials were continued, some varieties being rejected in certain of the islands. In Dominica the results were largely spoiled by the outbreak of three different diseases on the experiment plots. Two fungi occurred on the leaves—the rust fungus referred to above and identified at Kew as *Uredo arachidis*, Lagh., and a leaf spot fungus, *Cercospora personata*, Ellis. The same root disease fungus also attacked the roots, lower portions of the stem, pods and surfaces of the nuts. The rust fungus also occurred in certain of the other islands in that year. The results obtained throughout the islands were, however, considerably more promising than those of the two previous years.

Description of the Varieties.

A short account of some of the American varieties is given in *Farmer's Bulletin*, No. 356, of the United States Department of Agriculture. Descriptions of others have been obtained from local sources.

Spanish.—This variety is a strong-growing plant with upright stems and thick foliage. The pods are small, and are clustered about the base of the plant; they are rough and dark in colour, and each usually contains two nuts which entirely fill it. The pods adhere well to the plant when it is dug up, and are thus easily reaped. The nuts are light brown in colour and rich in oil. The period from the time of planting to maturity varies in the West Indies from twelve to eighteen weeks.

Carolina Running.—This variety has long trailing stems and thick foliage, which render it suitable for a green dressing. The pods are borne on the long trailing stems, and do not adhere well when the plant is dug. Each contains two nuts, on an average, which are about three times as large as those of the Spanish variety. The period from the time of planting to maturity is from sixteen to eighteen weeks in the West Indies.

Tennessee Red.—This variety is similar in habit to the Spanish, but the pods are longer, though small, and contain four, sometimes five or six, nuts of a dull red colour, crowded together. It is more suitable for stock-feeding than for market purposes. The period from planting to maturity varies from twelve to eighteen weeks.

Dixie Giant.—This variety is so called owing to the large size of its pods, while the nuts are about four times as large as those of the Spanish. It was found that it did not mature well in the United States, and this experience has been repeated in the West Indies.

The plants are trailing in habit, and the foliage is thin. The pods are borne along the trailing stems, but adhere well on digging. Each pod contains two large nuts, of a very light reddish-brown colour. The plants require from seventeen to twenty-four weeks to mature.

Virginia Bunch.—This is a somewhat dwarf plant with upright stems and rather light foliage. The pods are large and clustered about the base of the plant, and adhere well on digging; they are bright and clean, and contain two, or sometimes three nuts in each. The nuts are light brown in colour. The plants take fifteen weeks to mature in Dominica.

Virginia Runner.—This is a strong-growing variety with creeping stems and heavy foliage. The pods are scattered along the stems and do not adhere well on digging. In other respects it resembles the Virginia Bunch variety.

African.—This variety is also of a trailing habit, with dense foliage. The pods are borne along the stems and do not adhere well on digging. Each pod contains three nuts, of a light brown colour. These plants require twenty-four weeks to come to maturity in Dominica.

Gambia.—This variety is of a trailing habit, with dense, compact foliage. The pods are scattered along the stems and adhere particularly well on digging. Two nuts are produced in each pod. These are of light pinkish-brown colour. A strain having three nuts to the pod was found to occur occasionally in Montserrat. This has since been found to breed true.

Preparation of the Land, Planting and Harvesting.

The soil most suitable to this crop is a sandy loam containing a sufficient supply of humus. It should be well drained, free from weeds and in a good state of

tilth, especially on the surface. It is not advisable to use farmyard manure on the land in the same year as the nuts are to be planted, as by this means a large number of the seeds of weeds are introduced; this manure also causes the nuts to form large quantities of foliage and a high percentage of poorly filled pods. A green dressing may, however, be grown and turned in some few months before planting. It is probable that a moderate dressing of lime, at the rate of 1,000 to 2,000 lb. of freshly burnt lime to the acre, would prove advantageous on all soils except those containing an excess of this substance.

In the West Indies, the seed is planted in rows 1½ to 2 feet apart, and the plants are from 1 to 1½ feet apart in the rows. The greater distances apply to the trailing varieties. The nuts are shelled, and one or two are planted in each hole.

The plot should be kept free from weeds, but should not be disturbed after the nuts are beginning to form.

When the nuts are ripe, the plants are dug up and the pods removed by hand. They are then dried in the sun and stored in sacks or bags.

A thresher for removing the nuts in their shells from the vines is made at the Ellis Keystone Agricultural Works, Pottstown, Pa.; the General Southern Agent is Mr. G. C. Burgess of Petersburg, Va., from whom full information can be obtained. It is probable that other machines are also to be obtained, but this is the only one concerning which information has reached this office at present. (See *Agricultural News*, Vol. X., p. 41.)

RESULTS OF THE TRIALS FOR THREE YEARS.

The results obtained in 1907 were of a very preliminary nature, as the area planted was very small in each case. In consequence, little could be done beyond observing how the plants germinated and grew, and obtaining as much seed as possible for planting in 1908. A few points of interest are, however, worthy of record.

In St. Vincent, the Tennessee Red variety germinated very badly, and practicallly no nuts were obtained from it. The Dixie Giant plants were attacked by a rust fungus identified then as *Uromyces* sp. It is, however almost certainly the same as *Uredo arachidis*.

In St. Lucia, the Dixie Giant variety, which was the only one grown, yielded nuts which were found to germinate in the ground before they were properly ripe. This indicated the necessity for planting in that island at such a time as should allow the nuts to ripen after the end of the wet season.

In Dominica, the two American varieties made a good start and gave a satisfactory yield of cured nuts. It may also be noted that the 'African' variety which was grown in a larger plot of ⅛ acre gave a yield of 443 lb. of cured nuts, or an estimated yield of 3,569 lb. of cured nuts per acre.

In Montserrat, the results obtained were not very promising; the nuts produced by the Dixie Giant variety were considerably shrivelled.

In Antigua, the foliage of both imported varieties was attacked by caterpillars. These were kept in check by the use of a mixture of Paris green and lime in the proportion of 1 to 6. The soil of the plot was heavy, and did not appear very suitable to the plants.

In St. Kitts, the Dixie Giant variety grew well until October, when heavy rains fell just as the young nuts were forming. The rain caused renewed growth, and this resulted in the loss of many of the nuts.

In Nevis, the plants of both varieties dried off. This suggests the probability that they were attacked by a root disease.

The results of the trials conducted in 1908 and 1909 are summarized in the following table:—

YIELD PER ACRE OF CURED NUTS.

Where grown.	Variety.	Yield in pounds. 1908.	1909.		Remarks.
		Limed.	Unlimed.		
St. Lucia...	Carolina Running.	504			
	Spanish ...	no			
	Dixie Giant ...	Crop			
	Tennessee Red ...	obtained			
Dominica..	Carolina Running.	1,137		757	In 1909 all the plots were by diseases.
	Spanish ...	1,940		613	
	Dixie Giant ...	335		535	In 1909 part of crop was stolen
	Tennessee Red ...	459		370	
Montserrat	Carolina Running.	889	2,740	2,320	
	Spanish ...	364	1,440	1,320	
	Dixie Giant ...	failed to grow			
	Tennessee Red ...	400			
	Gambia ...	...	2,430	1,740	
	Local variety ...	...	320	286	
Antigua ...	Carolina Running.	680			
	Spanish ...	440	320	400	Soil is apparently unsuitable.
	Tennessee Red ...	400			
	Dixie Giant ...	960			Imported seed failed to grow in 1908.
St. Kitts ...	Carolina Running.	1,360	2,215	1,735	
	Spanish ...	300	3,090	3,307	Root disease, 1908.
	Dixie Giant ...	...	...	...	In 1908 the nuts rotted in the ground.
	Tennessee Red ...	300	3,170	3,200	Root disease, 1908.
	Local variety ...	1,800	1,470	1,200	
Nevis ...	Carolina Running.	1,400	2,667	1,813	
	Spanish ...	810	3,200	747	
	Dixie Giant ...	120			1908 The nuts rotted before ripening.
	Tennessee Red ...	360			
	Local variety ...	570			

On the whole, the Carolina Running and Spanish varieties have done best. Of the two, the Spanish is more likely to be popular as it is a bushy erect plant, and consequently easy to reap, while it ripens in from three to four months. The nuts are small; this is a further advantage, as they are frequently sold by measure and not by weight. This variety is, however, very susceptible to root disease. The Carolina Running variety has a trailing habit, and the crop is more expensive and troublesome to reap than that of the Spanish. This habit would, however, be an advantage if the plant were used as a cover crop or green dressing. The nuts are large and the yield good.

In Dominica the trials have been generally successful. A light soil such as is suitable to the crop is not difficult to find in parts of the island, and the opinion is expressed that the crop should be of use, particularly to peasant proprietors (*Report on the Botanic Station, Experiment Plots and Agricultural School, Dominica*, 1907-8, p. 31). The ill-effect of a heavy soil is well shown by the results obtained in Antigua. In both islands the soil was carefully freed from weeds and well prepared, but the results obtained in Antigua were unsatisfactory.

Another point that appears is the advantage of a dressing of lime in Montserrat and Nevis. In Montserrat the application was at the rate of 10 cwt. per acre; in Nevis at that of 1,200 lb. per acre. Trials with lime were also conducted in Dominica in 1909. A small plot was planted with nuts (the variety is not recorded) and half of it was limed with slaked lime at the rate of 13½ cwt. per acre. The limed half gave a yield of 12 lb. of nuts, the unlimed 9 lb. The result was, however, considerably interfered with by attacks of diseases. In 1910 the trial was repeated in Dominica with a new variety, Virginia Bunch. The area planted was 2,451 sq. feet, and

half of it received a dressing of lime at the rate of 8 oz. to the square yard, or 2,420 lb. per acre. The limed portion yielded a crop at the rate of 3,080 lb. of cured nuts per acre, while the yield from the unlimed plot was at the rate of 2,880 lb. per acre. Thus, lime would appear to be desirable as a dressing in Dominica also. The evidence as to the advantage of this in Antigua and St. Kitts is somewhat indefinite.

In general it seems that in the Islands named in the table, with the possible exception of Antigua and St. Lucia, imported varieties of ground-nuts will probably prove advantageous, more especially as they become acclimatized, and in consequence less liable to disease.

In order to obtain plants of the imported varieties which are likely to give the largest yields, it is necessary to plant nuts of these varieties obtained from plants grown in the previous season in any given island, and not to plant freshly-imported nuts each year. If this process is continued through several years, a strain of plants is obtained which is adapted to the local conditions, and is therefore hardy. The acclimatization is probably taking place owing to unconscious selection as much as any other factor. In connection with the acclimatization process, artificial selection of the best nuts from the most promising plants may also be conducted for planting purposes. Work of this kind is being done by Mr. Robson, Curator of the Botanic Station, Montserrat. There is no doubt that the effect of acclimatization and artificial selection will be to produce a strain of plants, of any of the improved varieties, well adapted to West Indian conditions.

Experiments in Dominica.

As has been stated already, these were conducted by Mr. J. A. Brooks, formerly Officer-in-charge of the Agricultural School, Dominica, now Assistant Curator, St. Lucia; it is from the report furnished by him that the following information is taken:—

Disinfection of Seed.—The first point that suggested itself for determination was the effect of disinfecting the nuts with a solution of corrosive sublimate, to destroy the root fungus on their surfaces, and to prevent if possible the rooting of the nuts of the Dixie Giant variety which had been observed in several of the lands where these were planted.

Preliminary experiments appear to indicate that treatment of the nuts with 1 in 1,000 corrosive sublimate solution did not reduce the germinating power, if the nuts were washed after this; while the reduction was small, even when washing was omitted.

Although the omission of washing appeared to reduce slightly the germinating power of the nuts, no serious harm was done by disinfection without washing. Consequently, it was decided to immerse the nuts for five minutes without subsequent washing before planting on a field scale.

In order to test the effect of this treatment on a field scale, an area of 2,556 sq. feet was planted with nuts of the Spanish variety. The area was divided into two equal parts labelled A and B. One and a half pounds of nuts were sown in each part, in rows 2 feet apart, and at intervals of 1 foot in the row between each hole. The nuts were planted 2 inches deep and two were put in each hole. Planting was carried out in July. The nuts in section A were disinfected before being sown, as described above; those in section B were untreated. The plots were reaped in the middle of November. Section A gave a yield of $74\frac{3}{4}$ lb. of cured nuts. Section B yielded $69\frac{7}{8}$ lb.

While the plots were free from root disease and leaf spot, the rust fungus appeared on the treated section on October 13, and, as no remedies were applied, it spread throughout the plot. It did not appear in section B until November 3, and even the plants nearest those in section A were unaffected.

Effect of the Rust Fungus.—The results obtained above also throw some interesting light on the effect of the rust fungus, as they indicate that this does very little harm. No individual plant was killed outright, either in this or in any of the plots, as it showed only on the older leaves and those nearest the ground. It was observed, also, that all the nuts from attacked plants were perfectly healthy, and showed no signs of shrinkage. Furthermore, a comparison of the number and total weight of the nuts borne on plants attacked by this disease with those of the nuts borne on healthy plants revealed no differences, so that in Dominica, under the conditions of the experiment, the rust fungus cannot be said to cause any very serious injury. The fungus appeared sporadically at different dates, in October, on plots situated some distance from one another, and attacked firstly those plants obtained from disinfected seed. There is at present no evidence as to the source of infection, and the land used had not been planted in ground-nuts during the previous year.

Comparison of Varieties.—A plot of a total area of 4,400 sq. feet was divided into five equal parts and planted with nuts of the Spanish, Tennessee Red, Dixie Giant and Carolina Running varieties. The nuts were sown in rows 2 feet apart with 2 feet between the holes in the row. Two nuts were placed in each hole at a depth of 2 inches. Sowing took place in July.

The nuts used were saved from the crop of 1909, and were all attacked by the root fungus, the mycelium being observed on their surfaces. They were disinfected for five minutes without subsequent washing. In addition, one of the five plots was planted with nuts of the Spanish variety which were obtained fresh from America and were not disinfected.

The yields were as follows :—

	Actual yield in pounds.		Estimated yield per acre in pounds.	
Variety:	Uncured.	Cured.	Uncured.	Cured.
Spanish (untreated) ..	19	15½	940½	767
Spanish (disinfected) ..	27	22	1,336½	1,089
Tennessee Red ..	29	24½	1,435	1,213
Dixie Giant ..	118	73¾	5,841	3,523
Carolina Running ..	108	76	5,346	3,762

The Dixie Giant and Carolina Running varieties gave by far the highest yields and bore the largest nuts. Unfortunately they are but little suited to the conditions of the market in Dominica, where small nuts are preferred, as they are sold by measure.

The disinfection treatment seemed to have prevented any occurrence of root disease, even from the diseased nuts used for planting and, moreover, appeared to have acted as a stimulant, as it very probably accounts for the difference in yield between the treated and untreated plots of the Spanish variety. The rust fungus, however, broke out on the Carolina Running variety on October 5, when the diseased plant was removed, and the surrounding plant dusted once a week with a mixture of equal parts of lime and sulphur.

On November 3rd, the rust fungus appeared on the section planted with the untreated seed of the Spanish variety, at the end of the plot remote from the Carolina Running plants. The other three sections, containing Dixie Giant, Tennessee Red, and the disinfected Spanish were free from disease. The sporadic nature of the attacks of the rust fungus on this plot suggests an outside source of infection. This has, however, not been discovered. On the whole, lime-sulphur mixture appears to have but little effect on the spread of this disease.

The Effect of Lime.—In order to test the effect of a dressing of lime at the rate of ½ lb. to the square yard, or 2,420 lb. to the acre, a plot of 2,451 square feet was divided into two sections A and B. Section A received a dressing of lime ; section B did not. Both sections were planted with nuts of the Virginia Bunch variety, in rows 2 feet apart with a space of 1 foot between the holes. One seed was sown in each hole.

The rust fungus broke out on section A on October 6, and on section B twelve days later, so that its effect, if any, was much the same on both sections. It is worthy of note that the lime-sulphur mixture which was applied had but little apparent effect on checking the disease.

The plot was reaped on November 15, practically four months from the day of planting. Section A, the limed portion, gave a yield of 86⅝ lb. of cured nuts, or an estimated yield of 3,080 lb. of cured nuts per acre. Section B gave an actual yield of 81 lb. of cured nuts or an estimated yield of 2,880 lb. per acre. This gives an increase of 200 lb. per acre of cured nuts in favour of the limed section—an increase so small as to render the experiment inconclusive.

The Effect of Unleached Wood Ashes.—To test this a plot, the area of which was 3,234 square feet, it was divided into two sections, A and B. Section A was the control plot, section B received a dressing of 10 oz. of wood ashes to the square yard, or 3,025 lb. per acre. The plot was planted with nuts of the Virginia Runner variety, planting being carried out as in the case of the Virginia Bunch variety used in the lime experiment.

The rust fungus occurred on both the plots at about the same time, and was not checked to any great extent by application of the lime-sulphur mixture.

Reaping was carried out on November 16, the nuts taking four months to mature. Section A—the control plot—gave an actual yield of 155¼ lb. of cured nuts, or an estimated yield of 4,182 lb. per acre. Section B gave an actual yield of 156 lb. of cured nuts or an estimated yield of 4,202 lb. per acre. This gives an increase of 20 lb. per acre in favour of the wood ashes plot– a result which is so small as to be negligible. It may be noted, however, that the seeds arrived late, so that the dressing was on the ground for three months instead of not more than two weeks before the nuts were planted.

In conclusion, then, it would appear that disinfection of seed is a desirable practice; that in Dominica the Carolina Running and Dixie Giant varieties gave the biggest yields, though they are not as desirable for the local market as varieties producing smaller nuts; that a dressing of lime of about 2,000 lb. to the acre is likely to prove advantageous; and that the rust fungus does not cause shrinkage of the nuts, or inflict any other serious damage in that island.

SELECTION EXPERIMENTS IN MONTSERRAT.

In the *Report on the Botanic Station and Experiment Plots*, Montserrat, 1909-10, mention is made of selection experiments with plants of the Gambia and Carolina Running varieties. The results obtained are interesting, and although the work has only been started recently, there is evidence to show that careful selection of seed from the best plants for planting purposes will have a considerable effect in increasing the yield and other desirable characters of these nuts.

GENERAL CONCLUSIONS.

(1) The disinfection of ground-nuts by immersion for five minutes in a solution of corrosive sublimate of a strength of 1 part in 1,000 of water before planting is a course highly to be recommended.

(2) The varieties most suitable to the different islands vary somewhat with the locality, but the Spanish and Carolina Running varieties are likely to prove most generally useful.

(3) An application of 1,200 to 2,400 lb. of lime per acre to the soil in which this crop is to be grown is likely to prove advantageous, at any rate in the islands of Dominica, Montserrat and Nevis.

(4) The effect of gradual acclimatization may do much to reduce the harm inflicted by fungi, and in conjunction with seed selection, to increase the yield given by the different varieties, so that a really useful addition to the agriculture of the islands will accrue by the extended cultivation of ground-nuts.

THE CULTIVATION OF COCONUT.

BY MANUEL ROXAS.

(From the *Philippine Agriculturist and Forester*, Vol. I., No. 3, March, 1911.)

Twenty per cent. of the Philippine exports in 1909 were coconut products, a fact that shows the extent of the coconut industry in these islands. Among the coconut growing countries of the world, the Philippines rank third, but the Philippine copra is poorest in quality. Our old method of drying and the common practice of using nuts not fully ripe, as well as lack of care in baling the products, are responsible for this low classification.

If we consider on the other hand the thousands of hectares of our land, suited to coconut raising, remaining yet untouched, and the meanness of the effort the improvement of our copra will require, there is no evident reason why we should not make of the Philippines the first coconut-producing country of the world, both as to the quality and quantity.

Supposing that we aim at this purpose, one of our first cares must be to stamp out all diseases that destroy our coconuts and reduce our profit. The *Uang* alone is causing a damage amounting in many localities to fully twenty per cent. of the crop. In spite of this fact no effective measure has ever been taken by either our farmers or the Government to eliminate this pest. But we should eradicate it and others hardly less serious, such as the red beetle and the bud rot, before we plant new tracts of land with coconut; for otherwise our new plantations will offer fresh breeding places for the pests, and thus aid in their propagation. Moreover, the labour which might be spent in planting new areas will render under present conditions no greater profit than it would if directed to the extirpation or the diseases mentioned.

In this paper it is intended to give some hints and criticisms for the improvement of our methods of cultivation, gathering of the crop, and the preparation of copra.

SELECTION OF SEEDS.

Little attention or none at all is commonly given the seed beds and the selection of seeds. Yet much is to be gained in the betterment of our nuts if we select the seeds and only plant those that are possessed of the characters suited to our purpose. For instance, when coconuts are raised for copra, big nuts rich in fatty contents are to be preferred, and if only seeds possessing those characters are planted, the next generation of trees will produce a greater percentage of such nuts, yielding on the average a better quality and larger quantity of copra. If, on the other hand, tuba is the principal product, trees yielding the greatest number of fruits are more desirable, for more sap is obtained from them. Seeds from such

trees are then used to produce seedlings. In selecting seed nuts, the characters of the trees from which they come are to be taken into consideration, instead of merely the character of the individual nuts.

But the great bulk of improvement will in most localities come from the importation of seeds from other places where nuts are of better quality. The coconut in La Laguna, for example, where copra is the principal product, may be greatly improved if this province imports seed nuts from S. Ramon, Mindanao. According to the census for 1904, from three hundred tc three hundred and fifty Laguna nuts are necessary to yield one picul (about 62 Kg.) of copra. About two hundred S. Ramon nuts yield the same amount. This great difference is due to the fact that nuts from S. Ramon are bigger and richer in fatty contents. Seed nuts from S. Ramon when carefully selected are worth from six to eight centavos each, placed in Manila. This price is almost twice that for local nuts. But the balance is far more than covered by the benefits derived from the use of big nuts with high fatty content.

Even if it is supposed that the Laguna and the S. Ramon nuts are relatively equal in their fatty contents, still the latter will have the advantage of being bigger, which fact means economy in labour, since men here are generally paid according to the number of nuts they gather or handle in making copra. S. Ramon is not the only place in the Philippines that produces good big nuts. There are first-class nuts in Pangasinan and other nearby provinces.

Transplanting and Distance Between Trees.

Seedlings are transplanted usually when they are from six to twenty-four months old. The sooner the seedlings are transplanted, the better start they are given and the more healthy and productive the trees will be. The age at which to transplant is regulated by economic conditions.

The distance between trees depends upon the fertility of the soil. On rich soils the trees must be farther apart than on poor ones; for in the former trees are thriftier, and, therefore, occupy more space than in the latter. Coconut trees grow admirably in full sunshine when furnished with a good supply of moisture in the ground. Their rate of growth is in proportion to the amount of sunlight they receive and the quantity of water they can draw from the soil. If they are, therefore, so planted as to shade each other, they make poor growth. Economic conditions also regulate the distance between the trees.

The arrangement of the trees to be recommended is the *quincunx*. It has the advantages that every tree is equidistant from its neighbours, and there is an increase of eleven per cent. over the number planted on a given area following the rectangular method. The *quincunx* is done as follows: a base line is laid out preferably parallel to one of the edges of the land. Divisions are marked on it, eight, nine or ten meters apart according to the space the trees are desired to have. These marks are used as centres, and with radii of the length of the desired distance segments of circles are drawn, the intersections of which determine the points at which to plant trees and the new points serve for finding others. The determination of the points and the digging of holes should be done several weeks before transplanting so as to weather the holes.

Care of the Plantation.

Catch crops are generally used in the Philippines after transplanting. For this purpose, those plants that do not exhaust the soil too much are best used. Such are *palay*, *camoteng cahoy*—the roots of which contain a large amount of starch used for the production of tapioca—or mango and other leguminous plants. Tobacco should never be used as it is a great nitrogen waster. Abaca grows faster at first than coconut, and when used for a catch crop covers the young trees in two years so as to make it hard for them to have a good growth. It is, though, used extensively for this purpose in La Laguna and elsewhere in the Philippines. Of course if the profit from it more than pays for the damage done the young trees, its use cannot be discountenanced. But as a matter of fact the damage done is greater than can be compensated for by the value of the abaca since the former is permanent.

This treatment is continued for a period of from five to ten years, after which the plantation is left to itself and grass allowed to grow in it. This practice must be condemned, for the land will be best used for shade loving plants, such as *cacao*, *platano*, *pina* and others. The cultivation required by the catch crop will incidentally free the coconuts from competition with weeds, thus giving them greater chance to make good growth. Another practice is followed in the Straits Settlements, East Indies and elsewhere, where the land is turned into pasture. The cattle

eat the grass and their excrement is scattered around the plantation and used as fertilizer.

FERTILIZERS.

The coconut makes good returns when fertilized; but in the Philippines fertilizing has never been done at least on a commercial scale. According to Semler, the author of the *Tropische Agrikultur*, when a tree yielding forty nuts per year is fertilized with a good stable manure, it will increase its production to fifty, and another yielding eighty will increase it to one hundred during the same length of time. The value of fertilizers can be seen right here, and we recommend to our farmers the use of any kind available. In some places where coconut oil is made there are oil factories that extract the oil for nothing and make their profit with the oil cake, called *poonac* in India. They sell this at high prices, to be used either directly as fertilizer or as a concentrate for livestock; in the second case the excrement of the animals is afterwards used as fertilizer. In these countries oil factories prove a success for the simple reason that they can dispose of their by-product as well as of the oil. The case in the Philippines is entirely different. So long as no application is given the oil cake, no oil factories can thrive well in these Islands. There are also commercial fertilizers sold by Behn Meyer & Co., Kerkhoven & Co., and others. The use of such fertilizers involves some expenditure of money, and we doubt if our farmers will use them, on a large scale. But we are sure that they can be induced to use leguminous plants for such purposes. These plants are nitrogen-fixers, better than ordinary manure as a provider of nitrogen.

In case stable manures are used as fertilizers, they are applied by broadcasting fifty cubic decimeters of the manure mixed with ashes, around each tree, and the ground hoed over. In Ceylon, cattle are fed grasses from the plantation, and their excrement is used as above described. Better results will be obtained if the animals are fed on leguminous forage crops planted in the coconut groves and their manure is left on the gound as a fertilizer. When commercial fertilizers are used the amount to be applied must be less and will depend upon their composition. The time of application as recommended by Semler is after transplanting on poor grounds and before flowering on rich ones. The period during which their results show varies from three to six years.

ENEMIES.

The coconut has two principal insect enemies in the Philippines, the *Oryctes rhinoceros*, commonly called *uang*, and *Rhynchophorus ferrugineus*, the red beetle, and also called *uang* by many. In the case of the former the adult insect does the damage, and in that of the latter the larvæ. In the College of Agriculture we have seen the case of a tree attacked by the larvæ of the *uang* (*Oryctes*), and the red beetle. The latter began the damage, and when the tree had started to decay the Oryctes laid its eggs, and its larvæ completed the destruction. The red beetle is far more dangerous than the Oryctes, for the latter's attack can be detected by the hole it makes and by the ragged appearance of the young leaves. But the symptoms of the attack by the red beetle are hard to see and tops of trees appearing healthy may suddenly be blown down by a strong wind. The cabbage of such trees is then seen to be rotten and full of pupæ of the red beetle. The red beetle, on the other hand, never makes its holes on the old tissue of the tree to lay its eggs, but almost always takes advantage of those made by the Oryctes; or when the soft tissues around the bases of leaves are exposed, makes its hole there. It is therefore doubly necessary to suppress the Oryctes, thereby freeing our plantations of two most dangerous enemies.

The best remedy for these insects is to burn all decayed trees, and other decaying stuff, keeping the plantation in a good sanitary condition. Trees attacked beyond recovery must be cut down and burned. Wounds on trees must be filled with cement or other substance, preferably poisonous to the insect. The practice of the tuba-makers of making incisions on trees to facilitate climbing them is a fruitful source of trouble, and must, therefore, be condemned. The young tissues around the bases of leaves must not be exposed to the attack of the red beetle by taking away the fibrous stuff around them. By reducing the number of these insects the damage done by them will be reduced. Preventive measures are always the best.

There also exists in these islands the Bud-rot, or the rotting of the cabbage, due probably to bacteria. This disease is highly infectious. Its symptoms, propagation, the method of combating, and the history of its appearance in the province of La Laguna are all described in a paper of Dr. E. B. Copeland, now

Dean of our College, published in May, 1908, in the *Philippine Agricultural Review.*

Gathering of Nuts.

The low quality of our copra is due mainly to the use of immature nuts, and to the poor method of handling it. The common nut-gatherers never allow the nuts to mature completely. Much is to be gained if, instead of gathering the nuts while on the tree, they are allowed to be dead ripe and to fall of themselves. They will be thus given time to concentrate their oil contents, and thus yield a better quality of copra. This method has two objections: one is the chance for the fruit to germinate on the tree before falling, and the other is the danger of the nuts being lost, or destroyed, after falling. The first difficulty in localities where it occurs can be avoided through seed selection; the second is easily remedied by keeping the plantation free from weeds. This practice may seem costly, but if we know how to relate it with others it will result economically. Letting the ripe nuts fall will suppress the bad habit of the majority of the nut-gatherers of making incisions on trees to aid in climbing.

Coconut Products.

The principal coconut product exported from the Philippines is copra. The total export of this article for nine months ending March, 1909, was 5,353,548 dollars, of which 2,774,131 dollars, representing 122,638,576 pounds of the article, that is more than one-half of the export, were imported by France alone (from the "Quarterly Summary of Commerce of the Philippine Islands" for January-March, 1909). But the Philippine copra is classed as the poorest, as can be seen from the following prices of copra from different countries in Marseilles, Dec. 11, 1909:—

For every 100 Kg.

Ceylon sundried ...	... 61	Fr.
Singapore ...	... 58	,,
Macassar ...	... 57	,,
Manilla ...	... 55	,,
Zanzibar ...	... 56·50	,,
Java sundried ...	... 60	,,
Saigon ...	... 56	,,
Cotonou ...	... 56·50	,,
Pacific Samoa ...	... 57	,,
Oceanie Francaise ...	... 57	,,
Mozambique ...	... 58	,,

(*From L'Agriculture Pratique des Pays Chauds.*)

One franc is worth about thirty-eight centavos.

Comparing the price given for the Manila copra with that of Ceylon sundried, the former is losing eleven per cent. by this difference in classification. If we could therefore improve our copra and succeed in classifying it among the best, we would increase our income eleven per cent. for this product. According to Prudhomme the superiority of the best copra is "to be mainly attributed to a very careful preparation and to the use of well-matured nuts."

Sun Drying versus Kiln Drying.—As has been pointed out in the beginning of this paper, the low price given for Manila copra is mainly due to an imperfect method of drying and to the use of immature nuts. It is worth while to quote Prudhomme when speaking of the different investigations on the effect of drying on the quality of the oil obtained: "One can, I think, draw from these investigations the following conclusions:

"1. The oil of the most pure and of the best quality are extracted from little coloured copra that proceeds from well-matured nuts.

"2. Drying by smoking and kiln drying, when poorly done, have the great inconvenience of yielding copra of a more or less dark colour, giving out a well pronounced smoky odour, and leaving as residue a cake of inferior quality.

"3. Sun drying gives the most excellent results when well conducted.

"4. The finest copra can only be prepared from perfectly mature nuts."

There are several ways of drying copra: kiln drying, smoking in "smoke houses," and by means of the sun. Stoves are also used.

In rainy countries where sundrying cannot be relied upon, and where farmers cannot afford to expend money for stoves, kiln drying can be resorted to, but fuel giving out the least amount of smoke must be used.

The desiccated coconut is a product largely consumed the world over, but not produced as yet in the Philippines. This article is used in making pudding and sweet-meats. 7,900,000 kg. of this product was exported from Ceylon in 1903.

The industrial preparation of desiccated coconut involves several steps: splitting of nuts and separation of meat from shell; the rasping of the meat to reduce it to small fragments; the desiccation and the baling of the product.

The meat after being reduced to a pulpy mass is put in a hot air stove, where it is kept at a temperature of 80° to 88° Centigrade. From this chamber the desiccated coconut is allowed to cool on wooden tables. Then it is cased in packages made from thin sheets of lead very similar to tea packages, and is sold in that form. Packages containing one-half, one, two, and three pounds of the product are prepared. Three average sized nuts yield a pound of desiccated meat. 6,700 nuts are necessary to produce one ton. (From Prudhomme Le Cocotier.)

The coconut oil is a product largely consumed at home. But perhaps for that same reason no effort is made to make it better. The factory of the Philippine Products Company, the first of its kind in the Philippines, run by Americans in Pandacan, exported in 1908 to the United States and to England 709,239 gallons of oil, valued at 265,069 pesos, and which were made from 5,325 tons of copra (Report of the Collector of Customs for 1908). Although this oil factory could not dispose of its by-product here and had to export a part, yet it thrived fairly well. Through internal troubles the company closed its business after the factory was accidentally burnt. The Philippine Products Co. would have gained a great deal more if it could have disposed of its by-product locally. It is important that we create a market for our factory by-products, if factories of any kind are to have a *complete* success.

COCONUT CONDITIONS IN LAGUNA.

By O. W. BARRETT.

(From the *Philippine Agricultural Review*, March, 1911.)

During the latter part of the past year the writer made a visit to the College of Agriculture at Los Banos, where he inspected the various nurseries, fields and plats under cultivation by the students of the College. From Los Banos a journey was made to Santa Cruz, the provincial capital, and from there to Majayjay, Lilio and Pagsanjan.

Only at a point about midway between Santa Cruz and Magdalena were there noted any active cases of bud troubles in the coconuts; here three trees with dead leaves (one with live fruit) were found at a short distance from the highway; the trunks of the affected trees were severely attacked by a comparatively small boring beetle. There was no odour, and no insects were noticed about the top. Only one stump was noted near the trees, and the leaves and buds of a felled tree had not been burned. I judge this disease cannot be the genuine "bud rot" which caused so much loss to the planters a few years ago. Discussions with the President of Lilio and others led me to believe that "bud rot" always kills the trees quickly and never allows the retention of any fruits after the death of the leaves; however, a rare affection is known among the coconut planters, corresponding to the cases here mentioned, in which the fruits are retained, and from which the trees may recover.

About ten dead and leafless trunks were seen standing at the edge of a plantation some 4 to 6 kilometers below Majayjay; very possibly these had been killed by "bud rot," and the trunks had not been felled as they should have been.

Considering the very close planting—5 to 7 meters—the health of the trees was all that could be expected; the yield, however, is probably not more than one-third of the normal amount for mature trees when well spaced. In a very few cases was there noted any attempt at cultivation between the trees; and absolutely no cases of "clean cultivation" were seen. Near Santa Cruz gabe, yams, and ginger were noted growing between rows of very old trees. A remarkably large percentage of mature trees were practically without fruits, due, doubtless, to the overclose planting and the utter lack of attention. If one-half the trees in some plantations were felled it is believed the yield of the area would be doubled.

According to the President of Lilio, the former planting distance was 10 varas (8·4 meters), but on account of the prevalent custom of selling coconut plantations at so much per tree, irrespective of quality, the present distance of 5 by 6 or at the most 6 by 7 meters has become very general.

Save at the Agricultural College at Los Banos very few coconuts were badly attacked by the oryctes ("uang") beetle. Practically no scale insects or fungus diseases were noted on the leaves anywhere.

Another great fault in the planting method of the Santa Cruz district is the setting out of young plants between the rows of the old or very unproductive trees; no case was noted of the felling of old trees in order to permit the growth of these young plants.

At Pagsanjan, the native oil mills and Senor Navarro's copra dryer were inspected. There is no question that some form of artificial dryer is very urgently needed in the Laguna coconut districts: first, because the smoke (creosote) permeating entire chunks of copra must render them unfit for higher uses such as making coconut butter, etc.; secondly, because the present method of drying over the husk and shell fire of the "tapahan" does not sufficiently reduce the moisture, and in consequence several forms of mold are noticeable on the product when it is ready for bagging, and this undoubtedly results in the loss of a considerable amount of the oil from the copra while *en route* to Europe. The native oil press does not, of course, remove all of the oil, as would a modern hydraulic or even a metal screw press; however, the quality of "cake" should be very high for feeding purposes because of its freshness and high oil content. I would suggest that one of the Hamel Smith patent rotary machines, which are claimed to completely dry copra in from two to three hours without a trace of smoke in the finished product be tried; one of these machines if set up either in Manila or Pagsanjan to demonstrate its usefulness to planters would, I believe, revolutionize the business in these Islands.

Considering the status of the coconut business in the Laguna districts, and comparing it with the same status in other countries in which I have had experience, I do not hesitate to say that the coconut planters in the districts inspected on this trip are getting only about 30 to 40 per cent. of the proper income from their plantations. And since there appears to be very little or no loss from insects or fungus pests, and since the soil and the climate appear especially well suited for this culture, I firmly believe that the said loss is due to the *faulty system of planting*, and to the *lack of cultivation* and *live legume mulching* in the plantations.

BROOM MILLET.*

By G. Marks,
Instructor of Agriculture, Hawkesbury Agricultural College, N.S.W.

(From the *Queensland Agricultural Journal*, Vol. XXVI., Pt. 5, May, 1911.)

The cultivation of broom millet in Queensland is largely extending, the industry having received a considerable impetus in consequence of the increased prices due to the demand for good fibre within the State, where up to the present the supply has been utterly inadequate to the wants of the broom manufacturers. In order to give all information on the subject to present and intending growers, we have, from time to time, published articles on the cultivation and subsequent treatment of the fibre. Lately a most excellent and exhaustive bulletin on broom millet, profusely illustrated, written by Mr. G. Marks, Instructor in Agriculture at the Hawkesbury Agricultural College, New South Wales, has been issued by the Department of Agriculture in that State, and we are permitted to reproduce it, together with the illustrations, in the *Queensland Agricultural Journal*. A thousand copies of the paper have been issued in New South Wales, and we feel sure that equal interest will be taken in the subject in this State.—Ed. *Q. A. J.*

From time to time numerous inquiries are received from different parts of the State asking for information regarding the cultivation, harvesting, and marketing of broom millet. During recent years the price has fluctuated considerably, according to the supply and demand, and in the seasons which follow an unusually high market, many farmers attempt to grow this crop who have but a slight knowledge of the requirements of the plant, and of the practical details from the selection of the seed to the harvesting, curing, baling, and marketing of the brush. The result is, that the market is glutted with millet of inferior quality, and the returns give little, if any, profit to the grower. We have in New South Wales soil and climate admirably adapted for the production of the best quality brush, and it is significant that those growers, whose practical knowledge teaches them to produce only the very best, are handsomely repaid for their outlay.

Requirements of the Trade.

In the manufacture of brooms three classes of brush are required, which are popularly known as "inside," "cover," and "hurl."

"Inside" millet is used for forming the inside of the broom, and is generally not more than 17 in. long.

"Cover" is the class used for covering the inside and also for forming the shoulders. It is longer than the former, and must be from 17 to 20 in. in length.

"Hurl" is the longest brush, ranging from 20 to 25 in. It must also be fine

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* Tamil *Cholam*, a little cultivated in Ceylon.

and straight, and forms the outside covering of the broom. To give a nice finished appearance, only prime hurl can be used.

About 1½ lb. of brush are required to make an ordinary broom, and the three grades are used in about equal proportions.

The soil, climate and methods of cultivation determine largely the quality of the brush, but in an average season there would be sufficient of each produced to satisfy the requirements of the trade. When grown under exceptionally favourable conditions, a larger proportion of long brush is produced. It may be used as covers, but owing to its length a certain amount has to be cut off, so that its use for this purpose causes unnecessary waste. On the other hand, a dry season will have the effect of stunting the growth producing a large percentage of "inside" millet, which can only be worked in the inside of brooms. Manufacturers have consequently to purchase elsewhere to satisfy their requirements.

It is not intended to go into detail concerning the manufacture of brooms, as this does not exactly concern the grower. Manufacturers require certain classes, and the farmer should aim at producing those classes which invariably give profitable returns.

CONDITION OF OUR SUPPLY.

At the present time there is a great deal of dissatisfaction amongst purchasers concerning the manner in which locally-grown millet is placed upon the market, so much so that the export trade has been injured, and the attention of the Federal Authorities has been drawn to certain dishonest practices with the view of bringing broom millet under the provisions of the Commerce Act. Whilst a large number of producers grade and bale their millet in a manner that compares favourably with the imported article, it is to be regretted that a certain section pay very little attention to these details. The chief faults may be divided into two classes—1st, those the result of ignorance and carelessness; and, 2nd, those which are brought about by unscrupulous individuals with the sole object of obtaining an unfair and undue advantage over the producer. Those of the former class may be summarised as follows:—

1. The millet is not graded. All classes are packed indiscriminately in a bale,
2. The seed is not removed, or only partially so.
3. Broken, bent, or coarse brush is mixed with the good.
4. The cut is not uniform. Some are cut close to the brush, others have 10 or 12 in. of stalk.
5. The colour is not uniform.
6. Bales badly packed and pressed. Many are irregular in size and shape, are not bound with a sufficient number of wires to stand ordinary handling.
7. Brush destroyed by being packed before it is properly dried, causing it to develop moulds of various descriptions.
8. Absence of distinguishing numbers of marks signifying the quality and weight.

A few of the latter class may be mentioned:—

1. The use of heavy billets of timber in bales.
2. Watering the interior of bales when packing with millet that has been properly dried.
3. Placing in the bales bundles of stems and leaves, useless brush, bagging, scrap-iron, sweepings of floors, quantities of unripe seed, &c.
4. Dressing the outside of bales with prime hurl and the middle with inferior material with the seed left on.

It is unnecessary to enlarge upon some of these dishonest practices, as their effect upon any market must be injurious. Owing to the bales being tightly pressed, and from 4 to 5 cwt. in weight, it is not always easy to detect these faults till they are opened in the factory. However, buyers are naturally becoming very alert, and they are compelled to give lower prices on account of the risk they run. Many manufacturers prefer to leave the local product alone, and import their supplies, finding it cheaper to purchase Italian millet at £40 per ton than use local material at £20. The size, shape, and general appearance of bales is fairly constant with individual growers, so that buyers very soon become familiar with them. These dishonest practices have already severely affected the New Zealand trade, and our millet is being replaced by Italian and Californian samples. As a consequence, every honest grower has to suffer through the evil reputation that his trade has acquired, and receive cosiderably lower prices for a first-class article, because of the fear that the agents will have to make some allowance to the buyers on

account of possible adulteration. The demand for broom millet in this State is limited ; and if its production is to be extended and made profitable, it is essential that the export trade be encouraged in every possible way. The local producer at the present time is protected by a Federal duty of £4 per ton.

Fully 90 per cent. of the millet produced in this State is grown on the rich alluvial lands of the North Coast; and on several of these rivers—notably the Hunter, Manning, and Richmond—the industry may be looked upon as lucrative and permanent. Many farmers have reported their success with this crop, and would not think of reverting to the far less remunerative occupation of maize-growing. The raising of millet need not be confined to these districts, as, with the necessary care, and the aid of a few home-made contrivances, any land which produces twenty-five or more bushels of maize to the acre will yield profitable returns. On many of our western slopes millet should also thrive, particularly in those localities where irrigation can be carried out. It is advisable, before entering extensively into the production of broom millet, to ascertain from agents or manufacturers the probable requirements of the trade, with the view of obtaining an idea of the price likely to be obtained during the season. At the same time, should the prices fall after the crop is harvested, the millet may, if properly cured and baled, be stored for a considerable length of time without injury.

The following information may enable beginners in broom millet growing to avoid some common mistakes, and not to neglect any of the important operations which are essential to success:—

WHAT BROOM MILLET IS.

Andropogon sorghum vulgare is a non-saccharine variety of sorghum. It is an annual, somewhat similar in appearance to maize while young; but it has thinner stems and narrower leaves, and, instead of having male and female flowers on separate parts of the plant, they are both found together in the brush at the top. The flowers are of two kinds—perfect and imperfect. The former are set directly upon the branch, and are accompanied by some of the latter, raised upon little stalks. The fine stems of the panicle or brush are the valuable portions; the other parts are incidental. The brush should be composed of seed stems, uniform in size, length, elasticity, and toughness, and of a nice bright colour. The soil and general methods of cultivation will largely affect the character and quality of the product, even though good seed be used. By long and careful cultivation and systematic selection certain desirable qualities have been developed and fixed, which remain only so long as the conditions which brought these changes about are reasonably observed. When a plant is grown for a particular purpose it should be the cultivator's aim to keep improving it in the direction most profitable to him. This necessitates a careful study of the plant and its requirements, and the conditions which make for its proper development. In broom millet it is not desirable to obtain a heavy yield of seed, a large development of stalk and leaf, or a sap full of saccharine material, but a special and unusual development of the long, thin stems of which the brush is composed. It makes very little difference whether a large plant is produced or a heavy crop of seed is obtained, provided these stems are long and fine.

CLASS OF LAND REQUIRED.

The soil requirements of broom millet are similar to those of maize. The best results are obtained from the deep, rich, well-drained alluvial lands of our rivers. It is, however, capable of adapting itself to a variety of conditions, and, with proper care and attention, sandy and even gravelly soils if thoroughly drained, will produce fair returns. Undrained lands make the working and cultivation more difficult ; the growth is generally slow and uneven, and there is always the liability of the crop becoming stunted and diseased. To ensure evenness in ripening, a soil uniform in character and fertility is essential.

PLACE IN THE ROTATION.

In the general rotation on the farm broom millet takes the same place as maize. It is not advisable to adopt the practice of growing it in the same piece of land continuously, unless suitable fertilisers are applied. It has been found, however, in dry seasons that it does not thrive as well on land following millet as where the previous crop was maize. The reason for this appears to be that being more drought-resistant, it continues to grow, and thus exhaust the soil of its supplies of moisture and plant-food when maize would probably cease growing. At the same time, as the brush is usually harvested soon after the flowers have set, the crop can scarcely be classed as a very exhaustive one, particularly if the stalks are cut down immediately afterwards. Where possible, it should follow a leguminous or root crop.

PREPARATION OF THE LAND.

To obtain the best results, the land must be properly prepared and brought to a fairly fine tilth before sowing. The previous treatment should be such as would destroy weed seeds. The presence of weeds in the early stages seriously interferes with the growth and cultivation of the young plants. Deep ploughing is recommended. This not only ensures greater feeding room for the roots, but it also has the effect of increasing the moisture-carrying capacity of the soil—a fact which must always be remembered, especially in those districts where the rainfall is limited and irregular.

The nature of the subsoil must also be considered. Clays should not be brought to the surface, but can be materially improved by subsoiling. Ploughing operations should be commenced a couple of months before sowing time. This not only allows the land to sweeten by exposure to the weather, but all vegetative growth turned under is generally well decomposed by the time the second ploughing takes place. In early spring the land should be well fined down by means of the harrow, disc, roller, &c.

SOWING AND CULTIVATION.

Sowing should not take place until all danger of frost is over and the soil is thoroughly warmed, so that the seed will germinate at once. September, October, and November are usually the best months. If planted too early there is not sufficient heat in the soil to cause the seed to germinate, and it will either rot or the young plants will be so weak that the weeds will very quickly outgrow and smother them. It may be sown about the same time as maize, or two or three weeks later, with advantage. Drills 4 or 5 in. deep are struck out with a plough (a double mould-board one is preferable) about 3 or 3½ ft. apart, and the seed planted along these by hand or machine. The latter is preferable, as it sows more uniformly; and, by using a fertiliser attachment, chemical fertilisers may be applied at the same time. An ordinary maize seed-drill which sows and covers the seed in the one operation, is one of the best for the purpose. During hot or dry weather the seed should be sown soon after the drills are opened and before the soil has had time to dry. When this system is adopted hilling can be dispensed with. It prevents a great deal of evaporation from the soil by exposing a smaller surface. Besides this, the plants, having their roots deep in the soil, have plenty of support, and are not so quickly affected by dry weather. The amount of seed varies from 5 to 8 lb. to the acre. When the plants are 6 in. high, they should be thinned out to 3 or 4 in. apart for rich soil, and more space allowed each plant in poor ground. With good, clean, and evenly-graded seed, the sowing may be adjusted so that very little thinning is necessary, thereby saving a tedious and rather expensive operation. The quality of the brush is affected to a very large extent by the manner in which this thinning is carried out. If too much space is allowed, the plants grow very strong and vigorous, and produce brush which is coarse and unsuitable for market. On the other hand if crowded too much they become very fine and weak. To obtain an even crop, it is essential to have uniform sowing and germination, and later on to thin the plants to a uniform distance. Some growers prefer to sow the seed in "hills" 15 to 20 in. apart in the drills, leaving from six to ten stalks to each. The seed should be covered from ½ to 1 in. deep, the depth depending upon the character and condition of the soil. If it is dry, deeper covering is more necessary than would be the case if the soil were in a good moist condition. Where labour is scarce, several sowings should be made in succession to enable the grower to deal with his crop at regular intervals, and not have the whole area mature at the same time. Rolling the land as the seed is planted ensures a quicker germination and a better stand, particularly if the soil is a little dry. When drilled, the roller at the rear of the machine is quite sufficient. Should heavy rains fall after sowing, and before the seed has germinated, a light harrow should be used as soon as the condition of the soil will admit. When 6 in. high the crop may be harrowed to keep the soil loose and to gradually fill in the drills, and thus destroy any young weeds. Broom millet makes rather slow growth for the first couple of weeks, and the cultivator should be kept going every fortnight or three weeks to keep the surface soil loose and friable, to conserve moisture, and prevent weed growth, and in every instance after rains. For large areas a two-horse spring tine cultivator may be used. When the crop is half grown under favourable conditions cultivation may cease; in any case the surface roots must not be disturbed by cultivating too deeply. In moist and exposed situations the crop may be lightly hilled as an extra support is necessary. It is during the early stages of growth that the cultivator is of greatest value, as the soil may then be loosened fairly deeply. The most critical period is when the heads are forming. If dry

weather should set in then, the brush will be short and stunted. It may be necessary in some districts to sow early or late in the season so that the crop will not come into flower during such trying conditions. Where irrigation is practised, it is essential to plant in suitably graded land and convey the water by means of open drills between the rows. After each application of water, and as soon as the nature of the soil will allow, the soil must be well cultivated to prevent caking and to conserve moisture.

MANURING.

On soils that are somewhat poor it is advisable to apply fertilizers. Such crops as cowpeas, field-peas, vetches, and clovers are suitable for green manuring, and may be ploughed under when they have reached the blooming stage or have been grazed off by stock. This latter system works well when mixed farming is carried out and stock of different kinds are kept. Any vegetable matter should be ploughed under early to give it ample time to decompose before sowing. Farmyard manure, if available, is also a first-rate manure to apply, as it not only supplies the elements required by the plants, but also improves the mechanical condition of the soil. Chemical manures are also valuable and are very easily applied. Superphosphate, bone-dust, dried blood and sulphate of potash will be found the most suitable. The quantities used for maize or sorghum will do equally well for broom millet. The following make a complete fertiliser, and may be applied at the rate of 2 to 2½ cwt. per acre :—

Superphosphate	...	80 lb.
Dried blood ...	...	64 ,,
Bone-dust ...	...	50 ,,
Sulphate of potash	...	30 ,,

The manures should be passed through a sieve to remove lumps and foreign substances that would prevent them from passing freely through the drills. They should be thoroughly mixed just before sowing, as if mixed any great length of time before required they are very liable to "set," especially if the weather is at all damp, and this necessitates breaking up and re-screening before use. It is impossible to state definitely what quantity of manure is required for each class of soil. Growers would do well to conduct experiments on a small scale with manure, mixed in varying proportions, and to notice which give the best results. Soils, even in one locality, often vary considerably in their chemical and physical characters, and by such tests the farmer may soon determine the most suitable mixture for his land. An excessive dressing of manure tends to produce a strong coarse brush.

BENDING THE HEADS OVER.

The practice of bending the heads over is not carried out extensively in this State, and as a result a large amount of bent brush is sent to market, which can be used only as "insides" or "covers." In many parts of the United States of America this operation is never neglected. When allowed to grow in the natural way, a large percentage of the brush will spread out and bend over on account of the weight of the seed, and thus reduces its marketable value. This is especially the case if there is good rain when the brush is forming. The rapid growth causes the panicles composing the head to become tender and unable to bear the weight of the growing seed. Strong winds, at this particular period, will also cause this, and grain-eating birds, when plentiful, are sometimes responsible for a great deal of damage.

This loss may be prevented by bending the head over, and the weight of the seed in maturing will cause the brush to lie close and straight. The turning must be done between the joints or nodes, as if done on the joints the stem will snap and the top die off. The bending checks the flow of sap a little, but the growth in the head is not materially affected. This operation is performed when the seed is beginning to fill out and the brush shows signs of spreading,

It should be understood that it is quite possible to grow millet without turning down the heads. Some of the best millet on the market is grown by farmers who do not favour the operation. At the same time there are seasons when a fairly large percentage is completely spoilt, and such losses could have been prevented by the adoption of this system. The stalks are bent about a foot below the base of the head, and, if the plants are very tall, there may be two bends. The heads should hang clear of the ground, so that they will not be damaged by rubbing or discoloured by the splashing of mud in rainy weather.

HARVESTING AND CURING.

No matter what care has been bestowed upon the cultivation of the crop, sound judgment must be exercised at time of harvesting. An excellent crop may be brought successfully as far as

this stage, and yet the result may be unprofitable on account of inattention to, or ignorance of, some apparently unimportant detail. The time to harvest and the various other operations required to prepare the millet for market are such as require some experience in order to do them properly. Even experienced growers are not unanimous on the point of when to harvest the brush, some cutting the heads when in blossom, and others harvesting later so as to obtain better developed seed possessing considerable nutritive value. The time to cut will depend upon the weather and the colour required. Manufacturers generally prefer a millet having a green tinge. It is then much tougher than when allowed to become nearly ripe. To obtain this green colour the millet should be cut when the seeds are in what may be called the dough stage. The brush is then fully developed, but the grain is soft. For some classes of goods a golden colour is preferred, in which case the crop is left till the grain is fairly firm. With a little experience it is easy to harvest a large area, and yet maintain a uniform tint. A strong knife (a pruning knife is very suitable) is used to cut the brush, and at least 6 in. of stalk should be left on. In dwarf varieties the brush should be pulled instead of cut. Select fine weather for this operation. Some growers bend the stalks of drills towards each other diagonally, about 2 or 3 ft. from the ground, forming a sort of platform upon which the cut heads are placed to dry. Others cut the whole of the stalks and lay the millet upon them.

DRYING IN THE FIELD.

In this State the millet may be properly dried in the field during the greater portion of the summer months. Should thunderstorms occur, the brush must be placed in heaps and covered with tarpaulins, sheets of iron, or other material. The time required for drying depends upon the season, but still, with fine bright weather, two days should be sufficient. The brush must not be allowed to get wet, as rain or dew soon discolours it.

DRYING UNDER COVER.

The finest colour is obtained by drying under cover, or away from the direct rays of the sun. The millet is left a couple of hours in the field for some of the moisture to evaporate before being taken to sheds fitted up with racks one above the other, so that the brush may be spread out in layers about 3 in. deep. It must be turned regularly at frequent intervals, and when nearly dry may be placed in thicker layers. This method requires plenty of space and a good deal of attention, and it takes longer to dry.

REMOVAL OF THE SEED.

The seed is removed by means of a hackler.

The machine consists of a roller studded with small iron spikes, mounted in a frame and made to revolve at high speed. A handful of the brush is held so that the roller comes in contact with the seeds, which are speedily stripped off. A firm at Morpeth specialise in millet machinery, and supply these in hand, horse, or belt power for about £4 10s. and £5 10s. respectively.

For small quantities a handy man can very easily make one, but it is best to purchase one, properly constructed, for treating large amounts.

GRADING.

The grading of millet is most important, and must not be overlooked. While grading cannot be done so cheaply or expeditiously on the farm as in the factory, still, in the growers' "own interest, it is essential that some grading be done." It should be sorted into at least three classes—"Inside," "Covers," and "Hurl"; and any which cannot be honestly included in any of these classes should be discarded. Green and Golden also should be kept separate.

BALING.

The various grades should be baled separately. For this purpose a press is required. One used for lucerne or other hay can be conveniently adapted for this purpose. It is important, especially where space is charged for in freight, to reduce the bulk as far as possible. The brush is laid with butt ends outwards and the heads overlapping in the middle. Battens may be placed on top and bottom of the bales, and when pressed the whole is secured by five fairly stout wires. The size varies with individual growers, but a bale 46 in. × 30 in. × 24 in., and weighing from 300 to 400 lb. can be recommended. Each bale should be legibly branded with an indication of the quality. There are several styles of home-made presses in use, but one that is coming largely into favour is made on similar lines to a wool-press having wire ropes and a lever.

YIELD.

The yield ranges from 10 to 15 cwt. of clean marketable brush and 25 to 30 bushels of seed per acre. The price of broom millet fluctuates considerably with the season; and while it may vary from £18 to £40 per ton, the general

average for prime hurl may be set down at £30, cover millet at £25 to £30, and inside millet at £20 per ton. Should the prices, however, be somewhat low when harvesting takes place, the millet may be stored for any length of time without deterioration, and disposed of when higher prices are obtainable.

On account of the seed not being properly developed, it is best to consume it on the farm. Its value may be estimated at 4s. per 4-bushel bag.

Selection of the Seed.

Special attention must be given to the selection of the seed. That obtained in the process of stripping should not be used for sowing. The practice of using such would speedily lead to deterioration and the production of inferior brush. Good reliable seed can only be obtained by sowing in special areas and allowing the plants to mature their seed naturally. Individual plants may be allowed to ripen their seed in an ordinary field, but there is always a danger of their being hybridised by pollen from plants having inferior brush. In any case, seed should be obtained from those which produce the best heads. By proper cultivation and selection the quality and yield of any variety may be improved. Where seed-eating birds are troublesome, it may be necessary to cover the heads with some light material, such as muslin, when the seed is commencing to fill out. The ends must be tied loosely round the stalk so as not to interfere with the free circulation of the sap. After harvesting the heads are thoroughly dried, threshed, cleaned and kept in a place secure from weevils and damp.

Where the conditions for saving seed are not suitable it is best to purchase from reliable seedsmen. There are several varieties on the market, but so far White Italian has given the best results in this State. At the same time, growers are advised to experiment with new varieties from time to time, or introduce fresh strains of those kinds they have in constant cultivation, with the view of finding out what particular kind is most suitable to their conditions.

By-products.

The object of the cultivator should be to produce brush of the best quality; consequently all other use of the plant must give way to this. In former years millet was allowed to develop a fair proportion of seed, but the diminished value of the brush was not compensated for by the value of the seed obtained. The finest green brush is usually obtained while the seed is in an immature condition, but in the production of good golden-coloured millet a fair proportion of the grain is more or less developed. This contains an amount of nutriment, and can be utilised for the feeding of stock, thus assisting in reducing the expenses of the crop. It is, however, generally more or less soft and doughy, and, if intended to be kept for any great length of time, should be thoroughly dried by spreading out in thin layers on tarpaulins. Growers who insist upon ripening their seed will secure brush of an inferior quality, which brings a low price upon the market, and if exported injures the trade.

Stalks and Leaves.

The plant cannot be recommended as a particularly useful one for feeding purposes. While young a certain amount of sugar exists in the sap, but this soon disappears, and by the time the brush is cut the stalks are more or less dry or pithy, and contain a large proportion of fibre matter which is unpalatable. For this reason very little use is made of them beyond turning stock in after the harvest to feed upon the leaves. The refuse should afterwards be cut up with a heavy disc harrow, or cornstalk cutter, and ploughed under for manure.

Prospects.

As the demand for broom millet in the Sydney market is limited, it is not wise to undertake the cultivation of extensive areas, unless the product is properly prepared and suitable for export. For this purpose, prime brush only should be baled; and, if the necessary details in harvesting and curing have been observed, there is no reason why millet should not be exported in a wholesale and profitable manner. On almost every farm the implements to plant and cultivate the crop are found. It will not pay any farmer to obtain the necessary apparatus to treat his brush unless he intends to grow the crop for a number of years. When prepared to do this, and he produces and sends to market millet of the best quality only, it will be found a very remunerative undertaking. In districts where freights are considerable, growers might co-operate and establish small factories, where the whole or portion of their brush could be profitably made up into brooms for supplying the local market.

TIMBERS.

TREE PLANTING IN TOWNS.*

(From *Nature*, No. 2,162, Vol. LXXXVI., April 6, 1911.)

The tree, standing singly, collected in masses forming woods, or grown as a beautiful avenue, is a fascinating object of study once the attention has been arrested upon it. Difficult it is to realise that an object of such size, majesty, and strength as a fine old tree represents has sprung from a tiny seed—a seed which if placed in the palm of the hand may, to the non-expert, prove indistinguishable from the seed of a small herb or grass of the field. Yet in the one case the tiny seed contains within it the germ which will produce a green monument of 100 to 200 feet or more in height, a living monument which will withstand the storms and changes of centuries, and may witness the downfall and uprise of dynasties and nations. Its seasonal garb does not pass through the kaleidoscopic changes of fashion which man in these later days is heir to.

The tree has but the four changes of garment which appear regularly with the changing seasons throughout its life, but this raiment has never failed in its attraction for man. Beautiful as are the tender greens of spring, the deeper, more mature greens of summer, and the brilliant tints of autumn, he who studies trees finds something equally beautiful, even if not more beautiful, in the stern grandeur, with its latent promise of strength exhibited in winter.

The tree has had a greater influence in the training and civilisation of mankind than is perhaps generally realised, certainly more than is realised by the man of the city and town. Long centuries ago the greater portion of the land of the globe was covered by vast primæval forests in which man lived a primitive existence, and against which he waged an unequal war. But he was dependent upon the forest for the greater part of his means of subsistence, whilst his house, furniture, cooking utensils such as they were, and implements offensive, defensive and cultural were all fashioned from the materials of the forest.

As man increased in number and became more civilised, he cleared larger and larger areas of the tree growth, and now took to living outside, but still in the neighbourhood of the forest. Still he depended upon the forest for most of the necessaries of life from the materials for constructing his house down to a chief portion of his daily food.

It was only with the great increase in number of mankind and with his concentration in certain localities, usually the fertile lowlands from which the forests had been cleared, that these sections of the human race began to depend less and less on the forest as one of the chief staffs of life.

But we see that the instinct of man in the earlier days in the history of the world was to look to the forest as nature's great storehouse from which he could obtain the necessities of his daily life. It is so with the nomadic races of the world at the present day. I wish to make this point, as it explains, I think, the inherent love of trees which lies in the nature of each one of us, though in the city-bred man it may to some extent remain dormant.

It explains another point on which I propose to briefly dwell, the instinct of man, if left to himself in a bare treeless region to plant trees or tree growth, or bushes even, to brighten the monotony of his otherwise dreary surroundings. For those of us who have experienced nature in its awesome loneliness in the absence of tree growth of any kind, know full well how appallingly depressing it can become.

In such localities man, if let to himself, will, I say, start planting trees and will take extraordinary trouble to make them grow. Some years ago I was deputed by the Government of India to visit Quetta, the beautiful capital of Baluchistan—that rugged province situated in the far north-west of India on the frontier of Afghanistan and Persia. Quetta occupies the central Highland of Baluchistan, and is a point of considerable military strategic importance. It is situated at about 5,500 feet, and is surrounded by great barren peaks ranging up to 11,700 feet. The railway climbs to it through a dreary rugged waste of rock and sand, with here and there little villages embosomed in trees and surrounded with small areas of crops. It is a wild country, and the history of Quetta fully illustrates my point that man in such a country will plant trees for dear life.

The main station of Quetta was formed after Lord Roberts's march to Kandahar. At the time the first houses were built,

*Paper read at the Town Planning Exhibition in the Royal Academy Buildings, Edinburgh, March 23, by E. P. Stebbing, Lecturer in Forestry, University of Edinburgh.

save for the fact that the villages around contained some poplars and willows and fruit trees, the site consisted of a barren plain. The planting was first started in 1878 by Mr. Bruce. After the evacuation of Kandahar, the work was taken up mainly by Mr. (now Sir Hugh) Barnes, General Sir Stanley Edwardes, who was in command of the troops, Colonel Gainsford, and Mr. Watson, the forest officer. A Tree Committee was formed and large nurseries established. The trees were obtained from Kandahar, a beginning being made in the winter of 1881-2, when some 60,000 cuttings or slips of the chenar or plane tree, poplar and willows were brought on camels from Kandahar and planted out along the roadsides and in the gardens. The planes were put on the main road, the Lytton Road. They form a magnificent avenue, now thirty years old, which gives a most grateful shade in summer considerably lowering the temperature. The growth of the trees was wonderfully rapid, irrigation being then, as now, employed to water them; for all the water in the country is brought in channels from the sources of the springs, its value being fully understood by the inhabitants, who show great ingenuity in constructing these water channels. Other roads were lined with poplars or willows, and if a mistake was made it was in planting the trees too close, and in planting the avenues on any one road of one species of tree only; and this mistake had to be paid for later on somewhat dearly, to which allusion may be made. The trees were attacked by cerambyx beetle pest (*Æolesthes sarta*), the grubs of which fed in the green inner bark—the growing layer—of the trees, and resulted in numbers of the poplars and willows having to be cut out and burnt.

Not only in Quetta, but also in all the cantonments throughout Baluchistan, the planting of trees forms one of the chief recreations of the British community, so great is the distaste of mankind, accustomed and used to tree and plant growth to exist without it. The whole of the work is carried out by the political and military officers stationed in that portion of the country, few if any of whom had, before reaching the country, any planting knowledge, and many of whom had confessedly previously taken but little interest in the growth of trees. Amongst the most enthusiastic of the planting community at the time of my visit was General Sir Henry Smith-Dorrien, now commanding at Aldershot, but then commanding the Quetta division, and he attacked and wiped out the "borer," as they called the beetle pest in his cantonments with as much keenness as he planted trees.

I have alluded to the fact that the major portion of the land surface of the globe was formerly clothed with vast primæval forests.

In the opening phases of his connection with the forest man waged a puny and ineffective war against the relentless growth of the forest, and had as much as he could do to keep a small clearing round his abode, and in many cases this was not attempted. Regions in the tropical world exist at the present day where this unequal and never-ending strife between man and the luxuriant vegetation of the forest still goes on usually in favour of the forest. With increase of numbers permanent clearings came into being, but the whole of the materials for house-buildings, &c., came from the forest. At the present day the aborigines of Central India and the Assam and North Burma Hills, as is the case with aborigines in other parts of the world, construct their habitations of wood, grass, and leaves; their household crockery and glass consists of gourds, with lengths of bamboo for the wine-glasses, whilst a considerable portion of their food consists of edible fruits and roots and leaves and shoots of forest trees, and when they can procure it, meat from the wild animals of the same forest.

But man, with increased numbers and civilisation, began a ruthless war against the forest, and is still carrying it on in America, Canada, and elsewhere with the result which now faces us. In Great Britain, once covered with forests, we have no forests at all and few woods of any size, and are at the present moment entirely dependent on our timber, &c., supplies being brought to us from outside. And the sources of this supply are diminishing, and are also being yearly indented on to a greater extent by other countries.

But long before the awakening as to the importance of forests commenced in Europe—a matter of a century of two only—man, the man in the rapidly growing cities and towns had realised the importance of the tree and the place the tree held in his existence. His primitive instincts, laid to rest whilst engaged in ruthlessly exterminating his friend, were aroused into an active repentance when he no longer had that friend at his door, and could no longer watch it garb itself in its brilliant seasonal changes of raiment, and no longer had its protection for himself

and his animals against cold or fierce winds, a hot sun, &c. He then commenced, after the fashion of man, energetically, but more or less spasmodically, to endeavour to repair the effect of his own destructiveness. To his surprise, however, he found it was by no means so easy to replace the trees on spots from which he had ruthlessly cut them. Nature's balance had been unduly interfered with; the rich store of good soil built up through the ages in her own storehouses of the past had been wastefully dissipated, and whereas she herself never asked the trees to grow on bed-rock, man did.

Also, as time went on, the atmosphere, especially in the larger cities and commercial centres, became polluted and vitiated with smoke and acids, and man, having no time or wish to study the method by which Nature reclothes the soil when left to herself after he had passed by, gave up his attempts to maintain trees near or within the areas, rapidly increasing in density of population in which he worked and lived.

We thus arrive at another stage in the history of man and the tree. The city increased in size; the population doubled, trebled, and quadrupled itself; the single-room tenement, as we were shown by Lord Pentland the other day, made its appearance and came to stay; the streets became narrower, the houses higher, and the tree itself disappeared. If we look at the large densely populated capitals of Europe and the great commercial centres of the present day, we find in both that in the parts occupied by the poor classes and workers the significance of the tree as the close neighbour and companion of man throughout a considerable portion of his existence on the globe has been forgotten or lost to view. But the instinct is there, deep implanted in the heart of each one. Even to the born and bred city child, the descendant of several generations of town-bred men, the craving for a sight of a green field or of a wood comes dimly at times. Probably most of us who are acquainted with great cities have come across instances of such. It was my fortune once to see a youngster from the slums of London taken into a Kentish hop-field. He came from one of the worst parts of the great city, and in all his little life had only seen a grimy plane tree and a dark, sooty green grass plot. In the train, so soon as the open country had been reached, he remained speechless. Once in the hop-gardens he recovered his voice, and went wild with excitement and delight. It was very easy to see man's instinctive love for wild nature and nature's growth there. Equally apparent is it in most of us born and bred in civilised countries when we come face to face for the first time with a tropical forest. Instincts and thoughts to which we fail to give expression surge up within us as we feel that once again we have come into contact with the original homes of our ancestors; and the feelings, mind you which are aroused by such a contact, which were aroused in that London lad in the hop-garden, are the very ones which it is to the interest of mankind to keep alive and stimulate.

Mankind does not seem to improve with his growing habit of congregating in dense masses in cities and towns. He appears, somehow, to lose something of that freshness and breeziness which we associate with the mountain top and find in the dweller on the mountain top. In our more spacious, if less civilised and cultivated days, we lived in closer touch with Nature, and there are those who say that in many ways we were better men for the contact. But the closer life in cities is doing something which, as I think, is even worse for human nature than this. We are losing some of the finer instincts, and cetainly our finer senses of sight and hearing, and even of smell. I do not speak from any medical knowledge of the subject, but simply from personal observations made during a number of year's contact with the folk of the jungles and mountainous regions of India. They can give us points and a beating in all of the last three; and yet there is no reason to suppose that our ancestors—the ancient Britons, who dressed in blue paint—were not possessed of these finer senses, and were not the equal in these respects, of the present-day aborigine.

Of course, I do not wish to be understood as saying that the town-and city-bred man can hope to remain the equal of the country man in his knowledge of Nature or in those senses which demand to be constantly used to be kept in high order. But my point is that a good deal more might and should be done to help the dweller in the densely populated portions of the great cities and commercial centres to keep to some extent in touch with Nature. He should be able to see and live with trees, and to see daily, not only on holidays or at the expense of a long walk, which he will not take, trees and areas of green grass and flowers. We who live in the open air and habitually enjoy such sights, and those who spend several weeks or months in the year annually in the country, find it difficult to picture the mind of a child

who has never seen a field of corn and red poppies rippling under the soft summer wind, or the waving tops of a green forest, or heard the soughing of the breeze in a pine wood; and yet there are probably hundreds and thousands such in these islands.

Now it should be quite possible for the rulers of every large city and town to see that open spaces are provided for the recreation of the inhabitants. Much has and is being done in this respect, and this exhibition is a witness to all it is hoped to do in the future. But I am not concerned here with the provision of the open spaces, but with tree planting and the beautifying, not only of the open spaces, a comparatively easy matter, but of the streets and their neighbourhood. When we talk of trees in streets, the usual idea is, I think, an avenue. Those who have seen the beautiful lime avenue at Trinity College, Oxford, know what a beautiful thing it is. An avenue is a very beautiful thing. But there are many streets far too narrow to take an avenue, and yet it is quite possible that there may be a situation at one or both ends where a tree or a clump of trees can be put; and picture the difference such a clump, changing in colour with the season, will make to the amenity of the street. Or there may be one or more small gardens where small trees or bushes and flowering shrubs might be grown, where bright green grass bands or plots may be put, and which if kept in order can be maintained bright and beautiful. Such clumps and bushes and grass bands and plots are, we know the natural concomitant of the more well-to do portion of the community. But so are they often the accompaniments of the better parts of the city and town. On the continent, for instance, you do not want for beauty in the fine boulevards to be found in Paris or Brussels; the Unter den Linden is a thing of beauty in spring in Berlin; whilst the famous Ring of Vienna is as fine a piece of city tree decoration as you could wish to see anywhere.

In these islands we are far behind the Continent so far as the beauty of our streets go. Boulevards as understood on the Continent are entirely absent from most of our big cities. In the exhibition I see on the wall two fine sketches of a new proposed road in Liverpool. These are laid out in the proper spirit, and certainly not one of the least important parts of the town planning is the laying out of spacious tree-bordered roads, or even better, because more picturesque, if space is available, with a double line of trees and a walk down the centre of the road, like the Unter den Linden in Berlin. Parks and open spaces we have in our great cities, and very beautiful many of them are. In many cases they are, however, situated at considerable distances from the densely congested poorer parts of the town.

Here in Edinburgh, a city the natural advantages of the setting of which it would be difficult to beat, I can picture George Street as having a very different appearance with a fine green row of trees down each side. I think the addition of a row on the shop side of Princes Street would add beauty to one of the finest streets in Europe, whilst, to mention others, Hanover Street, Frederick Street, and the other streets running off up the slope would look infinitely more picturesque with trees on either side; and once the trees were up they would break the force and chill of the most persistent prevailing wind I have met! But it is not only in the wealthier part of the city that work of this nature should be carried out. Trees should be planted in lines or clumps, or as single trees in the poorer and more densely populated quarters of the city. It should not be possible for a child to grow up in any quarter of a city without being in daily contact with trees and plant growth. It should be rendered possible for the town-bred child to know the changes of seasons, not merely by temperature only, but by recognising the early beginnings of life in the year with the first snowdrop, to be followed by the crocus, and shortly after by the budding of the earliest trees. It should be possible for him to know and, if he will, see for himself the trees and other plants flowering and seeding in due season.

It may be said that this will be difficult of realisation in the densely populated poorer quarters of the town. May I tell one more small story which I think points a way?

Some years ago I was stationed in Darjeeling, in the eastern Himalaya. Darjeeling is a town of considerable size, the summer headquarters of the Government of Bengal, and possesses one of the great views of the world, the superb snowy giant Kinchin Junga, to see which and Mount Everest beyond all devout tourists to India make a pilgrimage. The town is situated on a ridge and outlying spurs, the houses embosomed in Cryptomerias, oaks, and other hardwoods. Beautiful as is the place in itself, with its incomparable setting of eternal snows, it came to be recognised that much could be done with the

object of beautifying the station. Some roads were without trees, the banks and slopes between them overgrown with a tangled jungle growth; the gardens of the houses left much to be desired in many respects; the roads of the bazaar were dirty, and the offshoot paths overgrown with a matted mass of undergrowth, the home and breeding grounds of pestilential flies and microbes. At the instance of the Lieutenant-Governor, the late Sir John Woodburn, K.C.S.I., as fine and broad-minded a type of the British official as could be found anywhere, a motion was set on foot which had for its object identical aims with those, or some of them, the present Town Planning Exhibition is setting before the public, the beautifying of the town so as to render it a better dwelling place for those who had to spend their lives, or a portion of their lives, there. The question, once mooted, was taken up with enthusiasm; and it must be remembered that, as in Quetta, the population concerned mainly consisted of men who would only pass an uncertain number of years in the station, a transfer or final retirement home, ending their connection with it. In Darjeeling a strong Committee was formed, on which the Government, the Municipality, the local bar, merchants, house-owners, and private individuals, British and Indian, alike were represented.

The Government recognised, as was pointed out by the Lord Provost at Lord Pentland's speech the other day, that it was not to the Municipality (that is, Corporation or Town Council) alone that it should look for the carrying out of the scheme, that the whole responsibility did not rest with the Municipality alone. Whilst recognising the necessity of the Municipality being the first to move in the matter and promise its support, it was pointed out that every householder in the town had equally a duty to perform in aiding the scheme, and that no scheme could be complete or effectual unless each householder recognised such duty and was prepared to give solid help to further the ends in view. Donations and aid were asked for by the Committee from the Government, Municipality and also from the householders, and were forthcoming from each quarter. The Committee then proceeded to lay down in broad general lines its recommendations for giving effect to Sir John Woodburn's ideas, and these recommendations dealt with the widening of roads, constructing new roads, building up retaining walls to keep up banks and slopes, planting trees either as avenues or in groups or single trees, the pruning of existing trees which required such work, cutting unsightly undergrowth from banks and slopes and grassing such, cleaning up the gardens of such householders as could not afford to do the work, and in making provision for giving out seed or trees and shrubs where necessary.

The broad principles of the work having been laid down, a strong Working Committee was appointed, and the whole of the work done in the station in the year I am dealing with was done by that Working Committee. Householders who were well off were asked to consult personally the Working Committee as to the details of the improvements to be carried out in their own gardens, in so far as they affected the external appearance of the town, and to carry out the recommendations made themselves. They were also asked to aid the Working Committee by donating seed and plants to be planted in the gardens of the poorer classes. This work was done by the staff of the Working Committee, and under the personal superintendence of the latter. It was a common sight during that spring, summer, and autumn to see members of the Committee supervising work for a couple of hours before breakfast in the morning, men who would be spending the rest of the day in their offices engaged in their ordinary daily pursuits. As a result, the improvement in the appearance of the station was astounding, and fully repaid the time and labour spent on it.

I have quoted this example at some length because it shows that the question of the improvement of a town, and more specially the poorer and more squalid parts of a town, is no Utopian scheme. It should be quite possible to institute similar committees in every large city and town of this country. In the case of the larger ones, such as London, for instance, each local district could have its own local Working Committee once the broad lines of policy had been laid down.

Here in Edinburgh a working planting sub-committee of the town planning committee might be formed to look after the beautifying of the city so far as such could be advanced by planting work. For the poorer quarters of the town a definite scheme of planting, by which I mean not only the planting of trees and shrubs, but also the formation and upkeep of grass and flowers should be laid down and worked up too, as funds allowed, it being a *sine qua non* that only such work should be taken in hand

as could be looked after and kept up in years to come. To plant a row or avenue of trees, and then leave it to take its chance, usually an extremely poor one, of reaching maturity, is to throw away good money. Similarly, to plant areas of grass and leave them to become refuse and rubbish heaps or mud flats is merely to add to the squalor and untidiness of a neighbourhood. For the dwellings of the wealthier inhabitants, advice would be offered when demanded or suggestions made when it was desired to obtain uniformity of treatment in a particular locality or neighbourhood, or when the planting of a group of trees in a garden would afford a pleasing amenity for a neighbouring poorer locality. In the public streets the sub-committee should be given a free hand so far as tree planting and the formation of grass plots went. I have mentioned above how a street, such as George Street, for instance, which has great breadth, could be beautified by an avenue of trees such as black poplars, or sycamores, or elms. In other parts of the city horticulturists are of opinion that thorns and the service tree might be used, whilst in sheltered situations I should like to try the plane, lime, and even the horse-chestnut. I should like to go into greater detail on what might be attempted in Edinburgh on this head, but for one thing time will not permit of it, and for the other I should require to make a closer survey of the city in this respect than I have yet had opportunity to do.

There is one other point, however, in connection with tree planting in towns which applies alike to Edinburgh and all growing cities and towns. It is concerned not with tree planting but with tree felling. It is difficult to speak too strongly in disapprobation of the indiscriminate and pernicious felling of trees which usually takes place when a new block of houses is to be built or a new road laid down. No effort is made to first mark out the foundations or alignment to ascertain whether the trees must come down or can be left to afford a pleasing amenity to the district. Perhaps for the gain of a few shillings or through ignorance or gross stupidity they are ruthlessly hacked down, a few hours destroying the work of a century, and the stumps remain a lasting source of regret to those inhabiting the district, for they can never hope in their time to replace the trees so mercilessly destroyed.

The first rule for a town planning committee to lay down should be that no trees on areas in which building extensions are to take place should be felled or killed without a special permission being previously obtained.

In conclusion, I could wish to point one moral with no uncertain note, and that is the great effect on the amenity of a district and on its inhabitants which tree growth exerts. A barren country is depressing, and has a like effect on mankind, resulting in the coarsening of human nature. Can one be surprised at the low scale of morality and the absence of the finer instincts of human nature generally associated with coal-mining districts when one remembers that alike above and below the surface of the earth the miner finds everything black and lifeless? To merely travel through such a country is depressing. How much more so to live in it? And as it is with the Black Country, as it is called, so is it in the narrow street of the slums, where the blue sky is hidden by the smoke of the great city and plant life of all kinds is absent.

Give the people better homes to live in—it is a first desideratum—but with the houses give them the companions of their ancestors, the trees, the green grass, and the flowers, for there are species of each which, if properly looked after, will grow even in the murk of the great city.

PLANT SANITATION.

CLERUS FORMICARIUS, IN RELATION TO 'SHOT-HOLE BORER.'

By E. E. Green.

It may be remembered that an attempt was made last year to introduce living beetles of *Clerus formicarius*.

This species is carnivorous (in its larval stages,) feeding upon the larvæ of various wood-boring beetles. It had been suggested that it might possibly be of use to us as an enemy of our 'Shot-hole Borer' (*Xyleborus fornicatus*). A small sum was placed at my disposal by the Planters' Association of Ceylon

for the experiment. I accordingly commissioned an entomologist friend to go to Scotland to collect and despatch a number of the adult beetles. A large parcel of the insects arrived in due course; but the beetles had all succumbed during the voyage. The adult insects having failed to survive the long journey, I suggested a second attempt in which the larvæ instead of the beetles should be submitted to trial. A number of the larvæ were carefully packed in a tin box with what appeared to be an ample supply of their natural food. This parcel has just reached me. Upon examination of the contents, I find three living and apparently healthy larvæ, about three parts grown. The remainder have completely disappeared. I can find no trace of their dead bodies, and I am inclined to believe that they have been devoured by their surviving comrades after the latter had exhausted their proper food. This partial success shows me that it would be possible, with proper precautions, to introduce the living larvæ; but an examination of these survivors convinces me that they would really be of little or no use to us. They are much too large to be able to live in the galleries of our *Xyleborus*. Though the younger larvæ of the *Clerus* might be small enough to traverse the galleries of the Shot-hole Borer, they would not be able to complete their transformations there, and could, consequently, never establish themselves permanently in the tea bushes.

I fear, therefore, that we must give up all hopes of assistance from *Clerus formicarius*, and I cannot recommend any further expenditure upon this experiment. It may, however, be possible to find an allied but smaller species of Clerid that may be more suited to our purpose. I have been told of another British species (*Nemasoma elongatum*) which—though ordinarily excessively scarce—occasionally appears in large numbers in restricted localities. It preys upon a small beetle that tunnels in wooden palings, and on the rare occasions when it occurs, is said to effectively exterminate the borer upon which it preys.

LIVE STOCK.

SUGGESTIONS FOR CONTROLLING TUBERCULOSIS AMONG FOOD ANIMALS.

By J. S. LLOYD, F.R.C.V.S., D.V.S.M.,
Chief Veterinary Inspector for the City of Sheffield.

(From the *Veterinary Journal*, Vol. 67, No. 433, July, 1911.)

It will be useless taking up the time of this meeting in discussing the intercommunicability of human and bovine tuberculosis, because I think the conclusion of the Royal Commission on Tuberculosis, that the disease in animals and man is one and the same, is now generally accepted. That, I take it, is a sufficient reason why tuberculosis in food animals should be controlled, or if possible, eradicated.

Remembering that horses and dogs are not generally used as food for human beings in this country, although occasionally affected with tuberculosis, those animals may be at once eliminated from the subject under discussion. Remembering also that the disease is only infrequently seen in sheep, these animals can also be left out of account, and my only remark in connection with them is to ask the questions—Why is tuberculosis so uncommon among sheep? Is it because of the open-air life they almost invariably lead? Has the sheep a stronger power of resistance to the disease than some other ruminants? I am not aware that the latter matter has been investigated. Leaving out of consideration the presence of tubercle in ground game, and birds, as being of minor importance, we can thus narrow the food animals affected with the disease and used commonly as human food, to cattle and swine.

Tuberculosis is well known to be prevalent in both these classes of animals, but I do not propose to give statistics to prove that such is the case. Granting that it is so, what are the certain results, (1) as affecting the stock-owner, (2) as affecting the consumer of meat and milk from tuberculous animals?

It has been stated by some that the individual loss to owners of cattle by tuberculosis is not great, but remembering the prevalence of the disease, the fact that a certain number die from tubercle, and that a far greater number as a result of infection are unthrifty, there can be no doubt that taken collectively, tuberculosis among cattle and swine must cause considerable loss to the owners of such animals. That the meat of badly infected tuberculous car-

cases, and the milk of cows affected with tuberculous udders, are a menace to the health of the consumer probably no one will deny; hence, sufficient reasons why steps should be taken against tuberculosis among food animals, (1) to lessen the loss of the stock-owners, (2) to safeguard the public health.

In dealing with preventive measures we may conveniently consider what has been done so far under the two headings just mentioned. To assist owners of tuberculous stock practically nothing has been done in this country except by individual effort; whilst as to safeguarding the public health, certain recommendations have been issued by the Local Government Board, with the intention of assisting inspectors of meat when dealing with the carcases of tuberculous animals, and certain limited legal powers have been given to local authorities generally under the Dairies, Cowsheds, and Milkshops Order of 1899, and to a few of the larger cities in the country under the Tuberculous Milk Clauses, to deal with milk from cows affected with tuberculosis of the udder.

It will, however, be obvious, that in thus dealing with tuberculous meat and milk, local authorities are only following in the wake of the disease and its results, whereas, for any action to be of lasting and efficient benefit, the disease should be attacked at its source.

The Second Royal Commission on Tuberculosis recommended that steps should be taken not only against tuberculous meat and milk, but also to eliminate tuberculosis from amongst farm animals, but so far nothing has been done in the latter direction, and chiefly, I think, because of the expense such action would necessarily entail.

In order to effectually discuss any measures towards the elimination of the disease, it will be well for us to consider how and under what conditions the disease is spread, and what well-established facts are now known in connection with methods of infection, which can be taken advantage of in methods of control.

It is now well known that the disease, although occasionally congenital, is not hereditary, thus giving us the foundation fact that young animals are, generally speaking, free from the disease. It has also been well established that animals housed in insanitary and tubercle-infected houses, almost invariably become victims of the disease. It has further been established that infected animals sooner or later disseminate tubercle bacilli, from one or other of the natural openings of the animals' bodies; it may be the coughing of infective sputa from the throat and lungs, infective fæces from the intestines, infective urine and discharges from the genitals, or infective milk from diseased udders. Such being the case, can we wonder that houses inhabited by such animals become hotbeds of the disease, and that tubercle free animals brought for housing therein soon become affected?

Taking these facts into consideration it becomes obvious, that in order to eliminate or even to control the disease amongst farm stock we must (1) get rid of all animals suffering from the disease that are dangerously infective to other animals, (2) that houses inhabited by such dangerously diseased animals must be thoroughly disinfected before being again occupied by other susceptible animals, and (3) that young animals must be kept from contact with diseased ones, fed on non-infective food and reared in tubercle-free sanitary buildings or in the open air.

The open-air treatment of human consumptives has been proved to be of considerable benefit to patients, and its bracing qualities must unquestionably be of at least equal, if not greater, to young animals.

In order to carry out the above requirements, it is apparent that two things become necessary; first, to find out when animals are diseased; and second, to know when diseased animals become dangerously infective. Thanks to tuberculin, the first is a comparatively easy matter; periodical testing being all that is necessary in order to find out the diseased animals. The second is far more difficult. It is practically impossible to know when diseased animals become dangerously infective, and the only certain and effectual way to prevent infection is by keeping the healthy and diseased animals apart. It of course follows that once an animal is known to have become dangerously infective, the only proper course is to have such an animal isolated, if not immediately destroyed.

Such then are the foundation facts to be borne in mind when discussing preventive measures, or when suggesting methods of control. They embody practically the suggestions or recommendations of the Second Royal Commission, and have been put into force as regards testing and segregation by Bang, and as regards destruction of dangerous animals by Ostertag, both with measures of success.

A serious attempt to grapple with the disease has been made in America, particularly in the States of Minnesota, Pennsylvania, Wisconsin and Massachusetts, but in all of these States the work is badly hampered by want of funds. For instance, Wisconsin is estimated to have a cattle population of over three millions, but only 41,000 were tested, either officially or unofficially, during the year 1907-1908, a rate of progress which will take about eighty years to test once all the cattle in the State. Similarly in the case of Pennsylvania with its two millions of cattle and 60,000 tested it will take at that rate thirty-three years to test all the cattle once. It will therefore be granted that to take steps for eradicating the disease altogether, enormous funds would be wanted; even to deal with the dangerously infective animals a considerable cost would be involved, a cost which owners of stock cannot stand, and consequently must be borne by the State.

Bang, however, has shown that successful individual and voluntary effort to rear a tubercle-free herd can be done cheaply, and providing that great care is taken by the individual stock-owners concerned, great and lasting benefit results.

Two methods of controlling the disease thus become apparent; destruction of dangerously infective animals—that is, dangerous to other animals or human beings—to be dealt with by, and at the expense of, the State; voluntary attempts by individual stock-owners to rear up tubercle-free herds. The first of these methods was practically embodied by the Board of Agriculture in the Tuberculosis Order of 1909, now unhappily withdrawn. All authorities who have given careful consideration to this question of controlling tuberculosis welcomed the Order, but it met with considerable opposition from the ratepayers, because the cost was to come out of the local rates; and strange to say, city and country ratepayers opposed it for opposite reasons. Country ratepayers opposed because it would apparently benefit the public health of the towns at their expense, whilst city ratepayers welcomed the protection it gave to public health by safeguarding meat and milk supplies, but objected to pay rate-aid for the purpose, because the order made no attempt to assist owners and breeders of stock to raise tubercle-free herds and thus make a first attempt to reduce the number of tuberculous animals in the country.

Apparently both classes of ratepayers had good grounds for their objections, and whilst it is highly desirable that some efficient if only preliminary steps should be taken to deal with tuberculosis among animals, it would seem that any new Order made and put into force should be supplied with State-aid for both compensation and administration, and ought to give material assistance to pioneer owners of stocks who voluntarily attempt to establish tubercle-free herds of cattle and swine. Such action would certainly tend to reduce the amount of tuberculosis among food animals by removing the dangerous infective from all herds and would be a beginning towards obtaining clean herds in different parts of the country, the latter probably becoming centres of education for the benefit of neighbouring farmers. Further, the removal and destruction of the dangerous animals under proper veterinary supervision would in a large measure protect the public from the danger of consuming tuberculous meat and milk.

It has been mentioned above that the efforts of Bang and others in building up tubercle-free herds have been more or less successful. Failure has generally arisen through the accidental introduction of tuberculous animals into otherwise free herds; but knowledge of such a danger should cause greater efforts to be taken to prevent such an occurrence. In this country, no doubt, failures in many instances will be recorded, but persistent and steady effort by both the State and the stock-owner combined must prove advantageous in the end. It must not, however, be looked upon as more than a preliminary towards controlling the disease.

One step has been discussed, and in two countries put into force, that is "stamping out." In Belgium and Massachusetts it has been tried and failed. Taking into consideration the enormous cost it would involve, and the dislocation of the cattle breeding and milk and meat producing industries that must necessarily follow, I do not suppose that such a course would be seriously considered in this country for a moment, and it can consequently be summarily dismissed from further discussion.

A second step is one which demands much more serious consideration—I now refer to anti-tuberculous vaccination. I will not describe the technique or results of this method of immunizing young cattle against the attacks of tubercle bacilli. Various veterinarians on the Continent have, however, been working at it since 1884, although it is only much more recently that serious and to some extent successful attempts have been

made to carry it out on a fairly extensive scale. Von Behring, Rossignal and Vallee have been working at it, and lately M. S. Arloing (*Veterinary Journal*, June, 1910) has claimed complete success in from 40 to 50 per cent. out of sixty animals treated. The method of procedure adopted by the latter observer has been to modify the tubercle-producing properties in both human and bovine tubercle bacilli by a series of homogeneous cultures in the depth of 6 per cent. glycerinated bouillon, and at different temperatures and pressures. These modified cultures have been used for immunization purposes in three ways, subcutaneous, intravenous and digestive. By intravenous injection Arloing obtained 75 per cent. of complete successes, by ingestion 50 per cent., by subcutaneous injection 10 per cent. of complete successes and 73 per cent. of partial successes, and states that there is no ground for doubt and unrest as regards vaccination, and that he will not hesitate to use vaccines on a large scale.

As a preventive measure, even if only tentative, vaccination appears to me to warrant trial in this country, and as the results, whether successful or unsuccessful, would be for the good of the nation, such trials ought to be undertaken by the State.

To sum up, the only suggested measures for controlling tuberculosis in food animals which appear to me to be capable of being put into immediate action are :—

(1) An order by the Board of Agriculture compelling compulsory notification, investigation and slaughter of dangerously infective tuberculous animals—that is animals affected with "open" tuberculosis, with compensation according to carcase value, and prosecution for failure to notify.

(2) Pecuniary assistance by the State to owners of stock who are willing to attempt the production of tubercle-free herds, and agree to carry out requirements considered necessary to obtain success, special consideration being given to the production of tuberculin, free testing, segregation, sanitary buildings, disinfection, &c.

(3) Experiments in vaccinating young animals against tubercular infection to be carried out by, and at the expense of, the State.

All the above are of course only preliminary measures; success or failure will point the way for further measures in the future.

THE PREPARATION OF ANTI-RINDERPEST SERUM BY MEANS OTHER THAN THE INJECTION OF VIRULENT BLOOD.

BY MAJOR F. S. H. BALDREY, F.R.C.V.S., D.V.H., I.C.V.D.

(From the *Veterinary Journal*, Vol. 67, No. 433, July, 1911.)

The excessive cost in the production of anti-rinderpest serum on account of the animals necessary for "controls" led to the method of augmenting the amount of virulent material by means of "peritoneal washings" or "peritoneal fluid," as it is called in Muktesar. Workers in the Manila Laboratories of the Philippine Islands were the first to inaugurate this system. The method has been adopted here, but some of the testings of serum so prepared gave irregular results and led to the following experiments to definitely decide as to its value.

The technique of preparation is comparatively simple and short as follows :—(For fuller particulars read Ruediger, *Philippine Journal of Science*, Vol. III., No. 5.)

Control animals which are to be bled for providing inoculable material are injected into the peritoneal cavity with varying quantities of a 5 per cent. sterile solution of citrate of potash at a temperature of about 27° C. This operation is performed one hour before bleeding the animal to death. The injection being made in the flank and the quantity of fluid depending upon the weight of the animal. The weight of hill animals varies from 100-200 lb., and the amounts injected are from 1,000-2,000 c. c. of potash citrate solution. The fluid is collected from the peritoneal cavity immediately after the death of the animal. Every precaution is taken to ensure absolute sterility throughout the operation. The amount of fluid recovered is about 50 per cent. of what is injected.

The theory is that the fluid so obtained is as virulent as blood, and experiment has shown that a very small quantity is capable of reproducing the disease in susceptible bovines. The amount of defibrinated blood obtained from one of the above-mentioned controls is 1,200-2,000 c.c., and the amount of peritoneal fluid from 800-1,400 c.c.; it is therefere seen that the material for hyperimmunizing purposes is increased to more than 50 per cent. without any increased expenditure in animals.

The advantage of the method is evident; it is, however, necessary that the serum produced by hyperimmunization with this fluid should be as potent as possible in order to minimize the amount of the dose necessary for protective purposes, especially as susceptible animals such as hill, plateau, the cross-bred European and Australian stock require many times the protective dose necessary for ordinary indigenous plains cattle.

The following observations were made to test the power of serum produced from the injection of peritoneal fluid as compared with that produced from the inoculation of virulent blood only.

Plains animals are much less susceptible than hill cattle and produce a serum of less potency. The experiment was therefore divided into two series, viz.: (*a*) the comparison of plains serum made from blood injections as against that made from peritoneal fluid injections in these animals; (*b*) hill serum made from blood inoculations as against hill serum made from peritoneal fluid injections.

Charts 1 and 2 show the method employed in the serum preparation by means of the inoculation of virulent rinderpest blood into immunized plains and hill cattle.

Charts 3 and 4 show the method employed for the preparation of the serum by peritoneal fluid inoculations in plains and hills.

It has been found in this laboratory that the inoculation of doses of peritoneal fluid cannot be increased to the extent of blood doses. It has apparently a much more toxic effect and deaths have taken place as a result of it within two to three days with all the appearances of acute toxæmia. (Plate I shows the *post-mortem* appearance of the fourth stomach of a bull which died on the third day after inoculation.) Moreover, animals do not absorb the material so well, and sloughing of the skin and abcesses are not infrequent from its use. It has been noticed that an acute inflammation sometimes follows, resulting in a dry gangrenous condition of the skin which eventually peels off as a hard scale, occasionally necessitating the destruction of the animal.

These results are not apparent unless very large doses, *i.e.*, 3,000-5,000 c.c. are given. With the same quantity of blood no such result is seen. It is not caused by the material being septic, as frequent examinations have shown that the fluid is sterile, with the exception of rinderpest. Chart 5 shows the result of peritoneal fluid injection, in which death took place on the second day. There were gangrenous areas at the seat of inoculation, and the animal presented the toxic *post-mortem* appearances described above. Many similar results have been obtained, and the *post-mortem* appearances are always identical.

It was therefore considered inadvisable to use more than the dose indicated on the charts for the peritoneal inoculations. Although these doses are somewhat less than those of blood, they are as much as can be given to ensure absolute safety in their administration. The *post-mortem* appearance in Plate 1, showing the acute inflammatory condition, is very characteristic and always seen. Chart 5 shows the course of injection in an animal so inoculated. As death took place on the second day with the toxic *post-mortem* symptoms above mentioned—rinderpest *per se* could not have been the reason, and the conclusion is that a toxæmia is the cause of death. Plains animals are much more susceptible to this toxic influence than hill cattle. It is known that plains animals are less susceptible to rinderpest than the hill, and this may account for their greater susceptibility to the toxin. The results obtained in the Philippines with peritoneal fluid are much better than ours, and this may be accounted for by the same reason, *i.e.*, that all their cattle are apparently as susceptible as our hill animals.

In both cases the rapid method of making serum is adopted, *i.e.*, plains animals only one hyperimmunizing dose, and for hills two hyperimmunizing doses. Serums prepared by the above methods were tested as follows:—

The doses are arranged on a plains animals basis, *i.e.*, so many c.c. per 600 lb. of body weight. Lingard has shown that hill animals require eighteen times the dose necessary for plains animals, and as these latter are invariably susceptible, they were used for the test. Doses of 2, 4, 6 and 8 c.c. per 600 lb. were used to test the serum produced from hill animals, and doses of 6, 8, 10, and 12 c.c. per 600 lb. for serum prepared from plains animals. The doses were so arranged because the serum of plains is weaker than hills. In each case the amount of the test dose is multiplied eighteen times, because it is for hill animals and doses given in exact proportion as to weight in the ratio of 5 c.c. per 600 lb.

The following schedule shows the result in a tabulated form :—

Each of the above tests was done in two animals, but I only give one typical chart of each reaction :—

	Doses of serum.	8 c.c. reaction.	10 c.c. reaction.	12 c.c. reaction.	15 c.c. reaction.
Serum prepared by the injection of V. B.	With V. G. Plains.	Both mild reaction.	Both very mild re-action.	Both very mild re-action.	No reaction.
Serum prepared by the injection of peritoneal fluid.	With P. F. Plains.	One death, one severe reaction.	Both severe reaction.	One death, one severe reaction.	Both mild reaction.

Result.—Virulent blood is a 10 c.c. serum.
Peritoneal fluid is a 15 c.c. serum.

(*a*) Therefore serum prepared from plains animals by the hyperimmunizing with virulent blood is 33·8 per cent. better than that prepared by hyperimmunizing with injections of peritoneal fluid.

	Doses of serum.	4 c.c. reaction.	6 c.c. reaction.	8. c.c. reaction.	10 c.c. reaction.
Serum prepared by the injection of V. B.	With V. B. Hill.	Slight re-action.	Both slight re-action.	Both very slight re-action.	Very mild reaction.
Serum prepared by the injection of peritoneal fluid.	With P. F. Hill.	Death.	Both dead.	One death, one severe reaction.	Very mild reaction.

Result.—Virulent blood is a 5 c.c. serum.
Peritoneal fluid is a 10 c.c. serum.

(*b*) Therefore serum prepared from hill animals by the hyperimmunizing with virulent blood is 50 per cent. better than that prepared by hyperimmunizing with injections of peritoneal fluid.

(*c*) Serum from plains and hills in equal parts and made by blood injections is depreciated 42 per cent. by the addition of an equal part of serum made by the method of hyperimmunizing with peritoneal fluid.

Although the above results show a depreciation in the value of the serum, it in no way detracts from the practical utility of the method, in fact, it enormously increases the inoculable material, and I may say that, but for its application the laboratory would this year have been unable to turn out anything like the quantity of serum it has done on account of the shortage in the supply of hill animals for control purposes. It will be seen that the power of serum produced from plains animals by the inoculation of peritoneal fluid is less deteriorated in comparison to the blood method in similar animals than is the serum from hill animals prepared in the same way and compared with the blood method in hill animals. This accentuates the conclusion that the serum of rinderpest is an anti-toxic material and not entirely anti-bacterial. It has already been noted that plains are much less susceptible than hills, and yet from a material which is evidently more toxic than blood they produce a better serum, in comparison, than do the more susceptible hill cattle.

It is generally recognized that the more susceptible an animal is to bacterial influence, the less susceptible it is to the toxin of that bacteria, and *vice versa.* This appears to me strong evidence in favour of the above conclusion that anti-rinderpest serum is an anti-toxin. Experiments have been commenced on these lines, and the results of the investigation will form the subject-matter of another paper.

Conclusions.—That the method of employing peritoneal washings to augment the amount of inoculable virulent material is a good one.

(2) It produces anti-rinderpest serum of a high value, but less potent than that produced by blood inoculation.

(3) In comparison with serum from blood inoculations it is of greater value in the less susceptible plains animals than in the highly susceptible hill cattle.

(4) That its reaction is produced principally by a toxin which is rapidly formed under the vital influence of the peritoneal cavity.

(5) The inoculation of very large doses is not advisable in Indian cattle on account of the danger of death from toxæmia, the inability of the animals to absorb it subcutaneously, and the extreme caustic action it has upon the tissues.

(6) The method in the doses above described, and which are small in comparison to the massive blood injections is valuable in that a good serum is produced.

(7) Further experiments in diluting the fluid or mixing with blood may demonstrate improvements on the system as at present practised.

In the original, numerous charts are included showing the testing of the serum of animals prepared by both methods, and also a beautiful coloured plate showing the *post-mortem* appearances of the mucous membrane of the fourth stomach of a bull dead from the effects of a subcutaneous inoculation of peritoneal fluid.

THE SINGLE TESTING SYSTEM OF BREEDING FOR EGG PRODUCTION.

By D. F. Laurie,
Government Poultry Expert and Lecturer.

(From the *South Australian Department of Agriculture*, 1911.)

Poultry-breeders have long known that high egg production is a matter of strain, and that individual hens are heavy layers and others poor layers. It has long been the rule among experienced breeders to carefully select their breeding stock and mate them on modern principles; thus the well-known South Australian laying strains have been perfected. The high laying power of the original individuals have become fixed as a hereditary characteristic. Breeders at an early date noticed that a strain of heavy-laying fowls could be built up only by breeding from selected layers of marked fecundity. Guesswork gave uncertain and negative results, and it was long ago recognised that some method of measuring a hen's actual laying capacity was absolutely necessary. Trap-nests, as they are called, were invented and are still in common use. Briefly, they were so constructed that when a hen entered them to lay, in the inviting looking nest provided, she mechanically locked herself in and could not escape until her egg was collected and marked and her identification number recorded. The more modern practice in South Australia is to ascertain a pullet's egg production before she is bred from. It is a bad practice to breed from pullets or hens undergoing a test which may prove them to be worthless as breeders. Besides, it is abundantly proven that stock bred from pullets are not equal, in constitution and many other points, to stock bred from second season hens. I speak here of utility breeding for egg production, and am not concerned with the practice of exhibition poultry breeders. The construction of the pens is described later. My reasons for discarding trap-nests are as follows:—

1. Although there are many good trap-nests, I have known of many serious injuries to hens and pullets.

2. Some hens will not enter trap-nests; others become very excited and the egg production is seriously affected.

3. The trap-nests require constant supervision. It is quite wrong to leave a hen confined for any length of time in the small space provided. From a commercial point of view the cost of such attention is too great.

4. It is impossible to eliminate every source of error where trap-nests are used, and the records, though faithfully kept, are not reliable.

5. The poultry-owner who finds it necessary to apply a test to all his hens or pullets does not rank in my estimation as a breeder. It may happen that a breeder may yard his selected stock together and then trap-nest them.

6. The cost of trap-nests, either in cash or in time and labour, is more than is generally estimated, and there are constant repairs and renewals, of which we hear little.

My reasons for advocating the single pen system are—

1. There is no mechanical device to frighten or injure the fowl.

2. She is well-housed and has sufficient room for exercise.

3, All possible errors in identification are eliminated.

4. The general character of each fowl can be studied daily and without any trouble. This is, of course, a most important consideration.

5. You are in a position to control her food supply, and, by comparison with others undergoing the test, you accumulate valuable data.

6. By carefully studying the occupants of the various pens you will with greater certainty observe divergence from type, tendency to a general type, and other characteristics. This accumulated knowledge, especially if tabulated and recorded with pedigree charts and photographs of the individuals tested, becomes an invaluable record.

Selection.

The importance of systematic selection is gaining general recognition as the basis of the breeder's art. It is not, in my opinion, properly carried out unless on broad lines. The general tendency is for like to produce like, but only when selection has resulted in stock pure for the desired characteristics. The old and accepted theory was that in all cases "like begot like," but the great advance in knowledge of breeding, due to the application of Mendel's law of segregation, has made clear the exact conditions under which alone we can expect like to beget like. One of the most important discoveries of modern times is that of the purity or otherwise of the gametes (male and female germ cells); until this was recognised breeders were groping in the dark, and most of their results were more or less accidental. The value of selection, when proceeded with in the light of modern knowledge, is immensely greater than it was. We know that our first step in developing any one characteristic is to acquire by selection birds or animals in which that characteristic is pure. When once this is gained a course of rigid selection must give the maximum development of that particular characteristic. The limits of this article do not permit of detailed explanation of the various laws, nor even a brief account of the countless classical experiments which have been made in recent years. When egg production is the end in view our endeavours should tend to concentrate the energies of the pullet or hen on that function. This view of the case will at once indicate the unreasonableness of attempting to develop in one fowl the opposing characteristics of high egg production and maximum flesh development. Although a course of rigid selectional breeding will result in the production of strains of great layers, it must not be thought that a lasting structure can be erected and maintained upon any but a scientifically sound foundation. Mere selection for one characteristic is generally at the expense of all other characteristics, and the result of such a course would be a fatal lack of balance. Selection has its limits, but that limit is very far above the general average. It is not true that selection results in mediocrity: the method that so results is not worthy of the name of selection. Continued high egg production must be recognised as possible under two main conditions—(1) Through inheritance due to scientific selection with the view of fixing and developing that characteristic. (2) Through physical fitness of the hen or pullet. The processes of metabolism must be normal and capable of legitimate development. The inherited capacity for transforming the energy of surplus food into eggs instead of flesh and waste must be coupled with the physical capacity to do so. Egg development and the subsequent extrusion are both physical labour in a high degree, further emphasized by the actual shock of almost daily repetition. Therefore it is evident vigour and a robust constitution are important characteristics, the inheritance of which must be assured by fixation due to selection.

Other Points.

Although at first sight the modern conceptions of the laws governing inheritance seem complex, there are a few of such practical importance to the breeder that he may concentrate on these, almost disregarding all other points. Without fully discussing the latter generalisation, it may be remarked that the careful breeder will always notice when the accumulations of small deviations in any one minor point amount to a serious difference and will take action in time. To the poultry-breeder may be mentioned some of the so-called minor points when compared with the main one of egg production. I will name some of these, because there is a generally prevalent opinion that nothing is of consequence other than capacity for egg production—a fatal error due to misconception.

Type.—Generally speaking this is debatable ground, largely caused through misconception or perhaps ignorance. Type has been subject to modifications at various times. To state a case one would not be wise in attempting selection for egg production using as material the English exhibition White Leghorn, which is practically a breed distinct from the original Leghorn as introduced

to England forty years ago. As a general rule deviations from standard type end in other serious modifications.

So-called Fancy Points.—Many of these are characteristic of a breed in its purity, and are to a large extent distinguishing factors. Disregard of these may end in a gradual, sometimes sudden, alteration of a serious nature. The combination of certain external characteristics is pleasing to the eye; modifications often give displeasing results—a mongrel appearance. A strain of fowls may be pure for any one or several characters. Where a breed is pure for any character its inheritance can be calculated, but it is also certain that by selection any character can be either eliminated or fixed, as desired.

Broodiness.—For egg production it is of course highly desirable that the material characteristic known as "broodiness" be eliminated. This character is inherited in a definite ratio. In the present state of our knowledge the exact process of the reappearance of this lost characteristic in the non-sitting breeds is not known. It has been surmised that broodiness is due to a ferment or enzyme. That is probably the case, but the reappearance is due to imperfect demarcation of its "presence" or "absence." There may be another character, intensified perhaps by nervous excitement, which holds in check this character which, while really "present" in a very dilute form, is still capable of reappearance, and would thus account for a supposed mutation, or be accounted a case of atavism. The importance of rigidly discarding from the breeding pen any specimen showing the least signs of "broodiness" cannot be too strongly emphasized.

Structural.—Structural deficiencies, including weakness in the organs of reproduction, are definitely known to conform to the general laws of inheritance, and the inclusion of stock of this class can but end in disappointment. It may appear to the experimenter that the conditions are unduly rigid; so also are the laws of breeding. The work of the modern selector is in eliminating the results of the carelessness and mishaps of the past, and at the same time building up the general capacity of fitness for the prime result of high egg production. The true meaning of the modern conception of the purity of a character and its mode of inheritance is the fitness of the bird or animal to maintain that character in its highest form. Thus it is quite conceivable that a strain of hens may be so developed by selection as to possess the potentiality of very high egg production, and yet through non-elimination of a weakness in the organs of generation (inherited) the birds have but a short life of productiveness.

PEDIGREE.

An accurate knowledge of the pedigree of the subject of selection is most helpful; unless strictly accurate, the value is *nil*. From any starting point the process of selection must include an accurate history of each subject. Written records are alone of use because, however good the memory of the breeder, errors small or great are likely to occur, and time may be lost. In selecting and mating the breeding pens for the production of future generations, and for correcting errors, an accurate knowledge of each inmate of the pens is of vital importance. The due maintenance, through successive generations, of any characteristic depends on mating sexes both of which are pure for that characteristic. If one is pure and the other impure, the progeny will consist of a few pure and probably three times the number impure; that is to say in other words, if a tested layer be mated with a male bird whose dam was a poor layer and descended probably from a line of poor layers, the pullet progeny will certainly all be poor layers, some of which, if bred "in the family," might produce good layers in the second generation. To such an extent does this rule apply that experience teaches that the mating must be "in the line," and that the introduction of fresh blood, even of equal value as regards laying, will often give results similar to those where the pedigree was poor for laying.

FOUNDING A STRAIN.

First Year.—With due regard to the general principles enunciated, the breeding pen or pens should now be mated, and as large a number of chickens reared as can be properly accommodated without overcrowding. The difficulty in obtaining stock with a satisfactory and reliable pedigree renders it necessary to both "line breed" and "inbreed" so as to have as many matings as possible. In working according to Mendel's law the proper course is to breed the various generations *inter se* until segregation is definitely assured. This the breeder characterises as "inbreeding" and "undesirable." There is no more harm likely to result from this method if properly conducted than from any other method; less so, in fact. It is commonly asserted that change of blood is necessary to maintain vigour, &c. The truth is that it is necessary to gloss

over, in a happy-so-lucky way, the errors of the past due to a lack of proper conception of the importance of thorough selection. Never breed from the unsound or unfit and your work will progress, but if one parent be unsound no amount of fresh blood will give any definite improvement. Such a course may enable you to continue a faulty system not worthy of the name of "breeding."

Second Year.—Select from the progeny resulting from the first mating as follows, with due regard to type, constitution, activity, and main outward points generally characteristic of layers. Toepunch all chickens when hatched. Place numbered legbands on each adult retained. Enter number and detail in a book kept specially as a record of the breeding from year to year. Put each pullet in a single testing pen, and take her record for 12 months. Put the cockerels in spare yerds or pens, as far removed from the hens and pullets as possible. These cockerels will be wanted for breeding from in the second year. They may run with other hens not used in this scheme.

Third Year.—Select for the breeding pens all the pullets which gave a satisfactory yield in the single pens. 1. Mate some of these back to the old male bird. 2. Mate the rest with selected males of the same year and breeding. 3. Mate one selected cockerel to one-half of the original hens. 4. Mate one selected cockerel to the other half of the original hens. You will now have four groups, three of which are continuing the strain by line breeding, and the other group, No. 2 (one or more pens), will continue the strain according to Mendel's law.

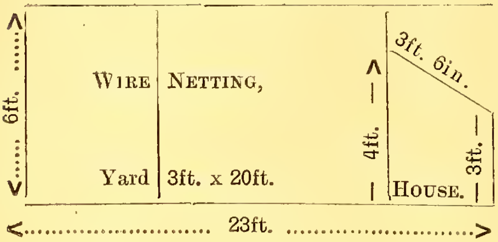
The Fourth Year.—Continue the line-breeding groups as far as desired, but the Mendel groups (inbred) should have given you at least one line of fowls pure for high egg production. If all your methods have been accurate, this strain will prove of the highest value. It is hardly necesary to point out that it is infinitely preferable to single pen each hen in the breeding season and to let the male bird selected be with each hen for a given period. Fertility may be depended upon, and, in addition, you may discover cases of sexual antipathy from which no good results can be expected, and re-mating must be resorted to. The utmost precision and accumulation of detail will give you certain results at an early date. Your work once done will be valuable and lasting. If otherwise, you will always be at work with indefinite and even negative results.

THE SINGLE PEN.

Some people who have had no practical experience of the system of single pen testing have expressed the opinion that the health of the birds must suffer, and that their subsequent value as breeders must be lessened, if not destroyed. Accumulated experience teaches the opposite, but of course much depends on the construction of the house and yard, forming the pen, and also the method of feeding adopted. In South Australia the mild climate admits of very simple but none the less effective structures. The severe climates of some other countries necessitate modifications in construction. In all mild to warm climates the materials used and the method of construction should offer as little harbour for vermin as possible. For Australia and similar climatic conditions the framework of the houses should be of hardwood free from all cracks, and should be moderately smooth. The covering material may be of corrugated galvanized tinned iron (narrow fluted), or compressed asbestos (fibro-cement) sheets. Weather-boarding, and similar material, offer harbour for vermin, and are liable to crack, twist, and warp. The single pens may be fixed or movable. The dimensions of the pens need be not more than 3 ft. by 20 ft. and the roosting and laying house 3 ft. square. To have the yards less than 3 ft. in width is inconvenient for the average person; any additional width adds to the expense of construction. Portable pens allow the ground to be changed daily, and where grass, clover, etc., are abundant, this method is much appreciated by the birds. Fixed pens are more convenient where large numbers of birds are being simultaneously tested. In all cases the pen, portable or fixed, should be numbered, and the hen therein should also have a legband with a corresponding number.

The continuous shed is most suited to this climate, and a permanent structure should be of the following dimensions for testing 20 pullets:—Length, 60 ft.; height in front, 4 ft.; height at back, 3 ft. Set out two lines of posts each 3 in, by 2 in. and 3 ft. apart inside, posts in each line to be spaced 3 ft. apart from centre to centre; set them about 18 in. in the ground and in perfect line and level at top. Now securely spike a soft wood rail 2 in. by 2 in. and housed flush into the posts and level with the top of back row of posts. A rail of same dimensions is similarly affixed to and 2 ft. from the tops of the front row of posts, which should be 6 ft. above the ground. The

iron forming the back of the house is buried 6 in. deep in the ground and then securely fastened to the top rail. As 3 ft. 6 in. sheets of iron are not made, a 7 ft. sheet cut in half serves the purpose. The roof is made of 7 ft. sheets cut in half and will then allow for a few inches to overhang front and back. The house divisions between the pens are best made of plain (flat) galvanized iron nailed to the posts and cut at top to the slope of the roof; the bottom should be buried in the ground about 3 in. or 4 in. A single sheet of corrugated iron, of which 2 in. are turned back, fastened in front of the house will provide ample shelter and act as a screen giving privacy to the hen and allow 14 in. space



Side Elevation of Yard and House.

for the hen to enter. This front screen may be held in position in several ways so as to be readily removed, or it may be permanently fixed. The opening left is 1 ft. 2 in. wide, and as the house is so small is sufficient to enable the eggs to be reached and the house to be kept clean. A shallow nest is hollowed out in the ground and lined with short straw or dry grass; a perch 1 ft. long and resting on a peg driven into the ground is all that is required. For a 20-ft. run two additional posts are required, and should stand 6 ft. out of the ground and level with those forming the front of the house; the end post should be strutted. The wire netting covering may be of 2 in. mesh or smaller and 6 ft. 6 in. wide. It must be let into the ground 6 in. and should be fastened to a galvanized wire, N. 8 gauge, tightly stretched from post to post at the bottom of the trench. This will prevent the hens from scratching holes and passing from one pen to another. Gates 3 ft. wide may be made of soft wood 2 in. by 1 in. bolted together with ¼ in. bolts and hung on stout tee hinges; the gate is covered with netting securely fixed. The pens should be roofed with wire netting stretched tightly and laced with binding wire to the netting forming the divisions. The door or gate should be provided with a reliable fastening, or may be padlocked for greater security. The runs may be floored with grass, hay, or short straw to a depth of 6 in. to afford exercise to the hen in scratching for grain, seeds, etc.; this is an important consideration with fixed pens. Portable pens must be strongly constructed and be placed on level ground; otherwise there is some danger that the hen will scratch her way out. Keep the hens busily employed scratching all day. In wet climates it may be necessary to cover the runs to keep them dry, but the hens will not remain so healthy. In cold climates the construction must be modified to suit low temperatures, and the house must be deeper so that a drop curtain may be used if necessary. There should be near the gate a small movable shelter, under which the food trough and water vessel, grit, and charcoal hopper may stand. In very severe climates (hot or cold) the back and roof may be protected with a layer of several inches of straw thatching, kept in position by wire netting of large mesh. This is very effective, and can be speedily renewed as required.

Feeding.

For Australia and similar climates I recommend the following foods:—Wheat bran (or sharps), wheat pollard (also known as middlings), cut greenfood, lucerne (alfalfa) hay chaff, clover hay chaff, animal food (fresh meat or meat meal), sharp grit, shell grit, small charcoal, and fresh clean water. Grain in variety according to climate; in Australia, wheat principally. The morning meal is prepared as follows:—One part bran to two parts pollard, varied slightly according to the amount of flour left in the pollard; to this add one-third by bulk of chaffed greenfood, lucerne, clover, or lucerne hay chaff which has been steamed for some hours in hot water. The animal food may be given in the form of soup made either of fresh meat or of meat meal and used to moisten the mash. Three or four times a week animal food may be given, but excess is a grave mistake. Fowls may eat insect life almost without limit, but animal food in the form of flesh or meat meals has a different effect. To give the quantities of meat scrap advised for some countries would end in speedy disaster in this country. Where oats are milled, finely ground oats will give good results as soft food or mash; and in very cold climates a little barley meal or corn (maize) meal may be added, but with caution. At midday a handful of chaffed greenfood (cabbage, kail, silver beet, clover, or lucerne) may be given. An hour before dark throw a handful of grain (good wheat for pre-

ference) in the straw litter; this will occupy the pullet for some time. Always keep grit (both quartz and shell), small charcoal, and fresh clean water in the pens. The water vessel should be cleaned out daily and refilled as often as required, and should be scalded and disinfected once a week. The method of feeding advised is one that will provide all the constituents necessary to fulfil the life functions and give a surplus for egg production. On no account should an attempt be made to force the egg production. You wish to ascertain what the hen will do under suitable conditions and on normal feeding, and you also hope to have a sound healthy hen at the termination of your test. Forced pullets are afterwards valueless as breeders. Avoid patent foods, spices, and other nostrums; they should have no place in the practical man's food-house. Endless harm has been caused to the poultry industry in all countries by the foolish practice of using nostrums, so-called tonics, &c. A carefully bred fowl, if properly housed in a well-vetilated clean house, needs nothing more than a sufficiency of sound, wholesome food and fresh clean water. Give what variety of food you can afford or obtain; but remember egg production depends on the use of food having the necessary constituents, and that what may suit pigs for fattening may not suit laying hens. All mash or soft food should be most thoroughly mixed by hand until of a crumbly consistency. Lazy people recommend shovels, &c., just as the workmen mix concrete; that is the lazy man's method and is very ineffective. Success in poultry feeding and breeding requires thoroughness in every operation and the avoidance of the lazy man's so-called "time-savers."

SCIENTIFIC AGRICULTURE.

THE CAUSES OF SALINITY IN SOILS AND THE METHODS OF RECLAIMING SALINE SOILS.

By W. H. Harrison,
Agricultural Chemist.

(From the *Madras Agricultural Calendar*, 1911-12.)

In all countries having a high summer temperature combined with a deficient rainfall, there occur tracts of land which contain such a high proportion of soluble salts that the growth of vegetation on them is hindered or even inhabited.

Under these climatic conditions, the texture of soil is an important factor in determining the appearance of saline substances in it. In loose open soils a considerable amount of percolation may occur with a small rainfall and thus remove the harmful salts. On the other hand in close heavy soils, and especially in those having imperfect drainage, little or no percolation occurs, and in consequence the harmful salts are not removed from the soil, but remain in solution in the soil water. During the dry season this water evaporates from the surface, where the saline substances accumulate as years go on. As these salts accumulate the natural vegetation becomes less and less, until it is finally killed and the soil becomes sterile. Again, the presence of an impervious layer in subsoil prevents free drainage to the land, and in the manner described produces a tendency for the soil to become saline. In fact, under many of the saline tracts in this Presidency such an impervious layer exists.

The substances which give rise to this harmful condition are numerous, but usually there are found in the soil the carbonate, sulphate and chloride of soda. These salts are produced by the decomposition of the rock minerals in the soil, and the type of saline soil produced depends upon the predominance of one or the other. Thus carbonate of soda gives rise to what is termed "black alkali," a condition which is most harmful to plant life. Sulphate and chloride of soda give rise to "white alkali," a condition which although exceedingly detrimental to vegetation is however less so than the black alkali.

It does not follow that because a tract of land is saline that this is due to the decomposition of the minerals in that soil. In many cases the harmful salts have been transported some distance from other areas, for, in well drained lands the soil solution percolates to a lower level, and the harmful salts are thus removed and finally are incorporated with the waters of the ocean through the agency of springs, streams and rivers. Occasionally, however, this drainage water finds its way into a tract

of soil from which there is no natural outlet and accumulates there causing that area to become saline.

In all saline land in addition to these harmful salts, there are present certain other substances which form the food of plants, and in fact for this reason alkaline lands are generally exceedingly fertile when once the obnoxious salts are removed from them, and consequently a considerable amount of attention is being paid to their reclamation in many parts of the world.

From the foregoing it is evident that the appearance of salinity is largely due to deficiencies in drainage, and the most successful methods adopted for the reclamation of saline lands are those which aim at improving the drainage of such land. Many methods have been suggested and employed for the alleviation of the condition of saline lands, and of these the most successful will be described.

A method often employed in previous years consists essentially in covering the saline land with a layer of fertile soil. This is brought about either by flooding the land with muddy water and allowing the latter to drain off, leaving the suspended matter behind, or by carting soil on to the area so as to cover it to a moderate depth. No doubt with a certain expenditure it is possible to obtain crops by this method, but the causes which produced the salinity in the first instance still remain in operation, and sooner or later the harmful salts are concentrated in the new layer of soil and the crops suffer. As an efficient and permanent cure this method cannot be recommended.

A second method consists in dressing the land with large quantities of gypsum (sulphate of lime), and this substance by reacting with the soda salts gives rise to other substances of a less poisonous character and permits crops to be produced. At the same time it affects the texture of the soil so as to improve the drainage. The application of this subs tance has undoubtedly been effective under certain conditions, but it is scarce in India, and therefore would probably prove too expensive for use by the ordinary cultivator.

Probably the most effective way of dealing with these soils is to well underdrain the land and then subject them to heavy irrigation with good water. The cost of underdraining is, however, comparatively high, and on that account would not commend itself to the ryot.

A cheaper variation of this method is to divide the saline area into comparatively large sections by means of deep open drains, the earth so excavated being utilized for the formation of bunds around the sections. Each section is then flooded with water to a moderate depth, and the water then percolates slowly through the soil to the drains carrying with it the injurions salts, Sometimes once flooding will clear the land so as to enable crops to be grown, but more often it is necessary to repeat the operation several times whenever sufficient water is available. Of course such a method as this is inapplicable wherever water is scarce as in many of the dry lands of this Presidency, but it can be carried out in many of the irrigated areas, and often where an efficient well supply is at hand.

The ryots of the Kistna Delta reclaim saline land by puddling in large quantities of paddy straw and then flooding with water. The straw in itself assists drainage, and even after decomposition has taken place the humus produced has the same effect.

THE ADVANTAGES OF DRAINAGE.

BY G. R. HILSON,
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Northern Division.

(From the *Madras Agricultural Calendar*, 1911-12.)

Every cultivator knows that if crops are to be grown successfully, one of the most important points to be considered is the question of water-supply. The question of drainage is equally important.

It may at first seem absurd that, after having incurred expenses either in digging a well or in acquiring the right to irrigate his lands from a tank or a canal, any one should go to the further expense of constructing drains, merely for the purpose of leading the water so obtained, away from the fields again, where it will be of no further use to the crop. There are, however, several advantages to be gained by good drainage which only need to be pointed out to be appreciated.

Any one who has observed such crops as cholam, cumbu, korra, etc., will have noticed that if during the earlier stages of growth water is allowed to collect and stand in the lowlying portions of the fields, the plants in these places are always pale, stunted and unhealthy looking, and that at the time of harvest

if they yield any grain at all it is only a very small quantity. A similar appearance is noted in the case of irrigated crops such as sugar-cane or turmeric when the irrigation channels are kept flooded with rain or irrigation water. Even paddy will present an unhealthy appearance, if the fields are submerged to too great a depth, or if water is allowed to stand for too long an interval at a time.

In all these cases the cause of this appearance is excessive moisture. It is, however, sometimes stated that it is due to lack of sun, but that this is not the real reason is shown by other plants in the same field being green and vigorous, although they do not receive any more sun than the unhealthy plants. Besides requiring moisture plants must have air. When flooding occurs, the air is driven out of the soil, water takes its place, and the land is then said to be water-logged. Under such conditions the roots cannot get air, and they are unable to grow and spread in the soil as they ought to do, hence the plants present the appearance described above.

Again, it is observed, more particularly in the case of the irrigated crops already mentioned, that besides giving a poorer yield than those grown under more arid conditions, crops which have been subjected to this treatment seem to exhaust the soil more, and in time of drought are the first to show signs of suffering from lack of moisture. The reason for this is obvious.

Since the channels are kept flooded, the roots of the plants are unable to penetrate deeply into the soil, but are restricted to the upper layer for their supply of food. As a result they remove much more plant food from this layer than a deeper rooted crop, which is not confined to such a limited area for its supply, and, therefore, the crop appears to be an exhaustive one. As an instance of this, the case of paddy after sugar-cane may be mentioned. It is never expected that a good yield will be obtained from the first crop of paddy taken after a crop of sugar-cane. That the yield is poor is simply because for the reasons given above, the sugar-cane crop has been compelled to become a surface feeder to the detriment of the succeeding crop. What has been said with regard to food supply applies to moisture. In time of drought the surface layer is the first to dry up, and with it, unless irrigation can be done, the roots of these plants which have been prevented from striking deeper. Thus, while a deep-rooted plant, drawing upon supply of moisture stored up in the lower depths of the soil presents a fresh and vigorous appearance, the shallow-rooted plant is withering and dying.

Further, it is well-known, that when land is newly brought under wet cultivation, it very often yields well. After a time, however, it begins to appear alkaline and the yield falls. This goes on until the land becomes so alkaline that the crops fail altogether and its cultivation has to be abandoned. In such cases it is usually noticed that while care has been taken to arrange proper means of irrigation, very little or no attention has been paid to the facilities for drainage, and in consequence this unfertile condition has resulted.

These are a few of the disadvantages of defective drainage; it will be noted that they tend to diminution of yield, even to total loss of the crop and to waste of water.

The following recommendations are therefore made :—

(1) *Dry Crops.*—Where the land is of a clayey nature and therefore likely to be water-logged during heavy rains, attention should be paid to the natural drainage channels to see that they are free from obstruction. Small depressions should be levelled up, but where larger ones exist trenches should be made to connect them with the drainage channels. These trenches should be about 1 foot in width and of sufficient depth to drain the depression completely. Where isolated fields of dry crops are cultivated in wet land areas, a trench of the same width as already indicated and as deep as the level of the ground will permit should be made all round the field to intercept and drain away the water which percolates through from the wet lands.

(2) *Irrigated Crops.*—The advantages of good drainage in the case of the sugar-cane crop were dealt with in an article in last year's calendar. What was said there applies equally well to other crops, where the system of beds and trenches is adopted. Where irrigation is done by means of furrows, these should be straight, of uniform slope, and should lead into a drain of slightly greater depth, and care should be taken that this drain is kept free, otherwise water will stagnate in the furrows.

(3) *Tsoudu Land.*—In this case it is advised that the affected land be divided up into small polts of about 25-50 cents in extent. These should be separated from one another by a deep trench, the deeper the better, which

should however drain freely. By this means, rain and irrigation water instead of stagnating on the land will sink into the soil and out into the drains, carrying with it the noxious salts. Where the land is not very saline, this process may be accelerated and the land at the same time enriched by growing Dhanicha (*Sesbania aculeata*). The roots of this plant go deep down into the soil, and on their decay leave channels in the soil; down these water is able to escape quickly, drainage is more effective, and thus the washing out of the salts is hastened.

THE VALUE OF DIFFERENT CROPS AS GREEN MANURES.

By A. D. HALL, M.A., F.R.S.,
Director of the Rothamsted Experiment Station.

(From the *Journal of the Board of Agriculture*, Vol. XVII., No. 12, March, 1911.)

Green manuring is a practice comparatively little followed in Great Britain, because wherever fodder crops are at all generally grown the land is suitable for sheep, and the standard custom of the country has always been to feed off the green crop with sheep. Wherever one sees vetches or mustard or rape being turned in by the plough on these light soils, it is generally because the farmer has an excess of keep, and fears he will not be able to feed off the fodder crop in time to get the land ready for the next stage in his rotation.

On heavy soils, however, where sheep cannot be folded, green manuring might well be more practised, especially as its value in improving the texture of the soil will be even more felt than upon the sands and chalk. Indeed, it is not unlikely that we shall see more green manuring in the future if corn prices continue to rise. Feeding stock is not always the most profitable operation upon the farm, so that many men would be glad to grow corn crops more frequently and reduce the acreage under roots, with their doubtful return for the very considerable expense involved, were it not that they feel they must make as much farmyard manure as possible in order to maintain the condition of the soil. It is in supplying the humus and in ameliorating the texture of the soil that farmyard manure becomes so indispensable, and though in this respect it cannot be replaced by artificial manures, yet a combination of artificial manures with the occasional ploughing in of a green crop will do everything that is necessary towards keeping the soil in the best possible condition.

It is not, however, the purpose of this communication to discuss either the value of the green manuring or the difficulties encountered in practice, but only to set out certain experimental results which have been obtained at Rothamsted on the relative value of different crops used for that purpose. Whenever green manuring has been discussed or advocated, it has been assumed as a matter of course that leguminous crops are the best for the purpose, because of the nitrogen they gather from the atmosphere and add to the soil on being ploughed in. It is this atmospheric nitrogen that accounts for the benefits which a good clover crop confers on the succeeding crops in the rotation, even though the green manuring is only that due to the roots and stubble left behind after the clover has been cut; but the value of the clover is still more pronounced if the second growth is not cut or fed, but turned in so as to form a real green-manuring, a practice which is not uncommon among the potato growers in the East of England. The classical illustration of the value of green manuring with leguminous plants is found in the reclamation of the sandy heaths of East Prussia by Schultz, who grew successive crops of lupins by the aid of mineral manures alone, and then turned them in until the soil had been built up. Considering this accepted power of the leguminous crops to enrich the soil in atmospheric nitrogen, it was somewhat surprising to find in the experiments at the Royal Agricultural Society's Farm at Woburn that Dr. Voelcker always obtained better results with wheat grown after mustard than after vetches, both crops having been ploughed in. The experiments at Woburn (*see Journal of the Royal Agricultural Society*, 1906, Vol. 67, p. 300, and 1908, Vol. 69, p. 348) have been repeated until no possible doubt of their validity can be left. On the average the yield of grain after mustard has been 50 per cent. higher than after vetches. When the Woburn results were first manifest, similar plots were started at Rothamsted on the Little Hoos field, in order to see if the results obtained on the light dry land at Woburn would hold for the heavier and cooler soil that prevails at Rothamsted.

At the time the experiments were begun in 1904, this field was in a very

poor condition, and more than usually short of organic matter, because it had been farmed for several years without any farmyard manure. No fertilisers were applied, but during 1904, 1905, and 1906, on the four plots rape, crimson clover, vetches, and mustard were sown, and turned in at the end of the summer. The treatment was repeated because the land was in such poor condition that none of the crops were large, the vetches and mustard growing better than either the crimson clover or the rape. A crop of wheat was taken in 1907, after which, in 1908 and 1909, the green crops were repeated, a second crop of wheat being taken in 1910. The following table gives the results for the two crops of wheat :—

Table I.—Yield of Wheat per Acre after Green Manuring.

Little Hoos Field, Rothamsted.

Previous Green Crop.	Dressed Grain.	Dressed Grain.	Offal Grain.	Total Grain.	Straw.
	Bushels.	Lb.	Lb.	Lb.	Cwt.
1907. After Mustard ...	29·9	1,923	96	2,019	22·5
1907. ,, Rape ...	21·3	1,376	75	1,451	29·6
1907. ,, Crimson Clover..	32·5	2,096	294	2,390	36·1
1907. ,, Vetches ...	39·7	2,542	210	2,752	39·4
1910. After Mustard ...	19·6	1,247	34	1,281	15·3
1910. ,, Rape ...	20·8	1,327	37	1,364	16·3
1910. ,, Crimson Clover..	30·8	1,926	85	2,011	27·0
1910. ,, Vetches ...	34·4	2,144	127	2,271	34·7

From these figures it will be clear, as, indeed, it was to the eye, that the superiority of the wheat after the leguminous crops of crimson clover, and particularly of vetches, is beyond any possible limit of experimental error. During the last year the value of the previous growth of vetches was particularly manifest, as the wheat on this plot possessed a fine colour, very free from blight, and yielded more than any of the manured wheat plots on the experimental ground. A plot on the same field, where the wheat had been manured with cake-fed dung after the preceding crop of barley, only yielded 20·1 bushels; indeed, all the manured plots in this field gave very poor results.

The following determinations of the percentages of nitrogen in the grain and straw would indicate that the superiority in the yield of the plots on which the vetches and crimson clover had been grown was due to the greater amount of nitrogen there available in the soil, but the general superiority of these plots over the wheat elsewhere must be set down to the better condition of the soil brought about by the accumulation of organic matter.

Table II.—Quality of Wheat Grown after Green Manuring.

Previous Green Crop.	Weight per bushel.	Nitrogen in Grain.	Nitrogen in Straw.	Ratio of Grain to Straw=100.	Ratio of Offal to Dressed Grain=100.
	Lb.	Per cent.	Per cent.		
1907. After Mustard ...	64·3	2·065	0·276	59·9	5·0
1907. ,, Rape ...	64·7	2·088	0·267	56·5	5·4
1907. ,, Crimson Clover	64·5	2·217	0·320	58·0	14·0
1907. ,, Vetches ...	64·0	2·386	0·441	61·3	8·2
1910. After Mustard ...	63·5	1·849	0·3162	74·8	2·7
1910. ,, Rape ...	63·8	1·852	0·3054	74·6	2·8
1910. ,, Crimson Clover	62·7	1·888	0·3756	66·4	4·4
1910. ,, Vetches ...	62·4	1·953	0·3595	58·4	5·9

The grain and particularly the straw of the wheat grown after vetches and crimson clover are much richer in nitrogen than the corresponding grain and straw following the non-leguminous crops, pointing to a greater amount of nitrogen in the soil available for the former crops.

Speaking generally, the results are what might have been expected from the known power of the leguminous crops to gather nitrogen from the atmosphere, but until the experiments have been repeated for a somewhat longer period of time it will be impossible to determine with any accuracy whether there has been any accumulation of nitrogen in the soil of the plots growing mustard and rape, though these crops are themselves incapable of fixing any nitrogen. One might expect that the soil bacteria, particularly the *Azotobacter*, would increase the nitrogen compounds of the soil when supplied with the carbonaceous matter which the green plant has drawn from the atmosphere. The *Azotobacter* organism which is present in Rothamsted as in most cultivated soils, is capable of effecting considerable fixation of nitrogen; but in order to do this it must be supplied with organic matter, by the oxidation of which it derives the energy necessary to bring the nitrogen into combination. Although it has been possible in the laboratory to raise the proportion of nitrogen in the soil by merely adding organic matter containing nitrogen, and thus giving the *Azotobacter* material to work upon, the evidence that this process goes on in the field is still very scanty. Samples of soil, however, taken from this Rothamsted field at the beginning of the experiment have been preserved, and further analyses after a few more green crops have been ploughed in may be expected to throw more light upon this question.

If the Rothamsted results, that vetches and crimson clover form good preparations for wheat because of the nitrogen they accumulate, are only in accord with what might have been expected, there still remains the entirely contradictory result at Woburn to explain. Dr. Voelcker has indicated that at Woburn the question is probably one of water supply; though the vetch crop does contain about twice as much nitrogen as the mustard which is turned in, it seems to leave the land in a drier and more open condition, and this on the light Woburn soil seems more to affect the crop than the extra nitrogen. It would, however, be unsafe to conclude that either the amount of nitrogen brought in by the two crops, or the effects upon the physical conditions of water supply of the soil are the only factors concerned. The process of decay which the two materials have to go through before the nitrogen they contain can be available for the wheat crop are very complex, and are likely to be different in two such contrasting soils as the cool, close Rothamsted land and the drier and warmer Woburn soil, and one is quite ignorant of the possible influence of the intermediate products upon the growing plant. It should be remembered that the opinions of practical men as to whether vetches form a good preparation for wheat are absolutely contradictory in different parts of the country. Some men have found that vetches are always followed by a good crop of wheat, while others hold that the result is invariably poor. It is interesting to find that this divergence of opinion on the part of experienced men is illustrated so distinctly by the contradictory results at Rothamsted and Woburn; evidently here is material for a study of the causes in operation to bring about such different results both experimentally and in farm practice. From the practical point of view the Rothamsted results would seem to show that on strong land the farmer will do better to sow vetches or crimson clover for green manuring than one of the non-leguminous crops.

THE PRACTICE OF ECONOMY ON ESTATES.

(From the *Agricultural News*, Vol. X., No. 231, March 4, 1911.)

In the present days of serious competition and low prices, a full recognition is being given to the importance of effecting the major economies on estates. The nature of these is well recognized, and they have become part of the natural routine in the work of the estate. There are others, however, whose existence is not obvious, which are the outcome of careful thought and consideration, in the light of what may be termed more purely formal knowledge. The purpose of this article is to indicate briefly the nature of some of these economies.

A larger proportion of the expenditure of an estate than is commonly recognized consists in the continual replacement of small articles. Where no inventory is made of such articles, and where the lists, even if they exist, are not checked every few months, losses are occasioned through careless

use, and through the misplacing of the articles, because as these are not regularly entered as estate property, the cost of buying them from time to time is considered to be a small matter. The keeping of accurate records of the purchase of such articles, and the consequent knowledge of the economy effected by the careful storing of them, will not fail to give the practical agriculturist an idea of the expense that carelessness in this respect has caused him in the past.

In the matter of the larger articles, such as the implements employed in cultivation, although these cannot be lost outright, neglect of care for them shortens seriously their period of usefulness and lessens their efficiency. When these are put aside for a season, the parts which have to bear the greatest wear and tear, more especially, should be dried, cleaned, and covered with an application of heavy lubricating grease. Attention may also well be given to those portions of them that do not receive direct wear, and here the care will consist in keeping such parts properly painted.

Some of the largest, but least obvious economies can be effected in regard to the animals employed by the agriculturist. Animals are required by him for the provision of energy, or for giving food products. In either case, the policy should be followed of treating the animals in such a way that the food absorbed by them is used as little as possible in doing useless work. Chief among the precautions to be observed in this way will be to see that the animals are stalled as near as possible to the places where they are wanted, and that they are properly protected against inclement weather. In regard to the former consideration, energy and therefore food are wasted where it is necessary to take the animals on the estates long distances to be worked, or in the case of cows to be milked. In the latter connexion, animals subjected to untoward conditions of weather must use energy in order to overcome the possible evil effects of those conditions. An interesting illustration of the extent to which the food and energy of an animal may be wasted in this way is supplied by the fact that, with cows, for every pound of rain evaporated from the body, there is consumed more than three-quarters of a pound of solid substance, reckoned as fat which might have gone to form milk.

In continuation, as regards animals, a large amount of the food is often wasted in providing energy for doing useless work in connexion with ploughing and hauling. In both of these care should be taken that the animal is attached to the implement or vehicle in such a way that as large a proportion as possible of the power given by it shall be used directly in the work that is required of it. Generally speaking, as regards ploughing, the line of the traces should be one and the same with a line passing through their place of attachment and the centre of greatest pressure on the mould board. With reference to haulage, in the case of a very smooth road such as that formed by a line of rails, the plane of the traces should be parallel to the surface of this; where the road is not smooth, however, the effect of the friction and the fact that the wheels are continually endeavouring to mount up out of the surface into which they have sunk, will make it necessary for the traces to slope downwards and backwards. Another matter of importance that is not usually recognized as regards vehicles travelling over ordinary roads, is the distribution of the load on the carriage. It is most usually, but not always, the case that the heaviest part of the load should be placed over the hind wheels, because firstly, the front wheels make a firm track for the hind wheels carrying the heavier weight; secondly, the hind wheels are generally the larger, so that they sink a smaller distance into the road, and use less of the energy of traction than would be consumed by the front wheels, with the greater part of the load on them; and thirdly, such distribution of the load enables the vehicle to be turned with greater ease and less damage to the road.

So far attention has been given to the animal, its mode of attachment, and the load on the vehicle which it draws. It is plain, however, that much more might be done toward the improvement of the roads themselves, on which the animals have to work. Bad roads mean constant expenditure in providing extra food for a continual waste of energy, and they also bring about unnecessary injury to animals, vehicles and implements. In the amelioration of such conditions, attention should be given to the provision of smooth and rigid roads with easy inclines, and where it is not possible to provide anything but a rough road, the conditions should be bettered as much as may be by the use of vehicles having large wheels with wide tires. It may be useful to mention here that a cheap and effective implement known as the road drag is much

employed in the United States for the economical improvement of roads in agricultural districts. In any case, to whatever extent the improvement of a road may have been effected, attention to its proper drainage is a matter of the first importance, if its best condition is to be maintained.

While mention is being made of roads in connexion with agricultural economics, it may be opportune to attend to the fact that much more use may well be made of means for overhead transport and portable railways. The latter are of particular application on estates already possessing permanent track for purposes like that of cane haulage, and where wide cultivation is practised. They can be made to connect with the permanent lines and form a means of effecting the carriage of estate products from the fields, and of manures to the cultivated areas, with no necessity for transfer, and with the greatest economy in the provision of energy for traction.

Another matter to which a large amount of attention may well be given is the practice of economy in the construction of buildings on estates. There is often a great waste of material when these are being erected on account of a lack of knowledge as to the relation between the size of the stuff used and the stresses that it can support, so that useless expenditure occurs in the provision of unnecessary material. In the same connexion useful consideration might well be given to the greater employment of round buildings in the place of those which are square or oblong. These are the most economical in construction, as they enclose the greatest area with the smallest provision of material, and where it is necessary continually to remove produce from one part of the building to another, as in places where stock is fed, economy is effected in the shorter distance which such produce has to be conveyed. In the West Indies, round buildings have a particular advantage in that they most readily resist high winds and hurricanes.

The subject may be extended almost indefinitely among other matters that have a more obvious connexion with it being economical methods of keeping manures; the constant provision of good drainage, especially for increasing the available moisture in the soil; the provision of wind-breaks for making plants grow better, preventing the falling of fruit and conserving the soil moisture; and the utilization of waste products from the estate. Though these and others equally important cannot be dealt with here, it is hoped that what has been said may suggest useful lines of thought in connexion with the practice of economy on estates.

AGRICULTURAL FINANCE AND CO-OPERATION.

AGRICULTURAL CREDIT IN ITALY.

(From the *Journal of the Board of Agriculture*, Vol. XVII., No. 12, March, 1911.)

The first number of the *Bulletin of the Bureau of Economic and Social Intelligence*, published by the International Agricultural Institute, which was referred to in the December (1910) issue of this *Journal* (p. 760), deals, among other subjects, with that of the present state of agricultural co-operation and credit in Italy. The first, and for many years almost the only, form of co-operative enterprise in that country was co-operative credit. Societies known as Popular Banks were formed in the towns on the Schulze-Delitzsch principle adapted to the special conditions of Italy. Later, Rural Banks, formed on the Raiffeisen system, began to be established, and the number of these has grown rapidly year by year. The "rural banks" especially serve the small farmer, while the "popular banks" by preference deal with the proprietors of estates of large or moderate size and with tenant farmers.

Popular Banks.—These banks are essentially organs of credit for the great industrial and agricultural middle classes, and they have their headquarters generally in urban centres. They have the form of limited liability companies, and the nominal value of their shares varies from a minimum of 5 francs (4 shillings) to a maximum of 100 francs (£4). The popular banks assist agriculture in several ways: they discount the bills and acceptances of rural banks, and, in addition to the ordinary forms of credit, a large number of these banks grant loans to farmers upon mortgage, credits on current account, and loans upon guarantee.

The popular banks have no federal organisation, but there are several regional groups. In addition, there is

the Association of the Popular Banks, which was founded in Rome in 1876, and is principally a propagandist body. In 1870 the number of popular banks existing in Italy was about 50; at the present time there are about nine hundred with a total capital of £10,000,000, and with more than half a million members.

Rural Banks.—The rural banks complete in the country the work of the popular banks in urban centres. The first of the rural banks was founded at Loreggia in 1883. In ten years their number had grown to 129, and to-day, it is stated, that there are about 1,800 of these banks existing in Italy, of which about 1,300 have been founded by Catholics, while 500 are neutral in religion.

The rural banks, which by their Constitution can deal only with their members, have for their principal object the provision of capital to the peasants (small freeholders, farmers and metayers) for their different requirements, without excluding loans for purposes of consumption, or those not directly devoted to agricultural purposes. They have no capital of their own, or at least no initial capital, but they receive savings deposits; and only when these are insufficient do they borrow the necessary capital from other institutions (such as popular banks and savings banks,) or have recourse to private people who have disposable capital. The loans are made at an interest slightly higher than the ordinary interest paid on deposits or on money borrowed by the society. This little difference serves for the expenses of management and for the constitution of a reserve fund, capable of placing the bank in a condition of comparative independence and of greater stability. The services of the officials are gratuitous.

The reserve fund, in case of dissolution, is devoted to purposes of public utility. The maximum period of repayment is fixed by the rules, but there are two kinds of loans; the first of relatively short duration, not extending over a period of more than two years; the others with a longer duration, extending even to ten years. Loans of the first kind are generally renewed every three or six months; those of the second kind are repaid by instalments which include the interest.

Of the 500 non-Catholic banks, 130 belong to the National Federation of Italian Rural Banks, which was founded in Padua in 1887. It has its headquarters now in Rome, and its object is to unite the Italian rural banks "in one single federation, to encourage their diffusion, facilitate their development, to care for and protect their interests in every way." The Federation assists affiliated branches with advice, and in their negotiations with larger institutions, and also in the purchase of agricultural requirements, and, when requested, it conducts inspections and examines their accounts. It sends out lecturers on agricultural subjects, co-operation and thrift, and conducts experiments in the use of chemical manures. The Catholic rural banks are nearly all united in regional and provincial or diocesan federations, and they are almost all registered in the Italian Federation of Catholic Rural Banks which was recently formed at Bologna.

Other Institutions.—The agricultural banks of the district of Parma are somewhat different from those above described, but rather on account of their different historical origin than any difference in economic principles. They are of a non-sectarian character, and are intended to benefit agriculture; hence they lend to applicants only when they have assured themselves of the agricultural purpose of the credit asked for. The banks of the district of Parma are eleven in all, and they belong to the "Federation of Agricultural Banks of the Parma Apennines," and deal with the Savings Bank of Parma; they thus act as intermediary institutions of this bank in its credit operations with the farmers.

The Bank of Naples is authorised by law to do agricultural credit business in the provinces of Southern Italy and in the Island of Sardinia with legally constituted societies and institutions, preferably those of a co-operative character. Similarly, the Bank of Sicily is authorised to do business through the medium of local co-operative institutions, that is to say, agricultural banks, in the form of co-operative societies with unlimited liability, and agricultural trading societies constituted among agriculturists in the form of co-operative societies, or agricultural associations constituted as corporate bodies. According to the latest report of each of these banks, the number of intermediary institutions of the Bank of Naples was 1,542, of which 764 were "credit-worthy," and the total amount of loans made to such institutions was 4,200,000 francs (£168,000); the number of institutions having relations with the Bank of Sicily was 157, and the business done with them amounted to 4,000,000 francs (160,000).

Mention must also be made of the Institution of Credit for Co-operative Societies, which was founded as a limited liability company at Milan, in 1904, with the assistance of the larger popular banks and of some co-operative societies. Its object is "to assist the development of co-operative distributive societies, co-operative productive societies, labour co-partnership societies, and credit societies for the benefit of artisans, clerks, peasants and metayers, and small freeholders, facilitating, by means of credit, the work of such societies." This institution, which has a paid-up capital of a million francs (£40,000) and deposits to the amount of three million francs (£120,000), and has made a strong position for itself in nearly all Northern Italy and in several of the towns of Central and Southern Italy, inaugurated in the first months of the past year a special "Section for Rural Banks." This Section will, in addition to granting loans and accepting deposits, discount bills, open current accounts, and, if different ways, encourage the work of the rural banks and institutions of a similar character.

For several years Italian co-operators have expressed the desire that the State should take the initiative in forming a central credit institution for the benefit of co-operative societies. In response to this desire the Minister of Agriculture introduced into the Chamber of Deputies on the 11th February, 1910, a Bill for the "Institution of the Bank of Labour and Co-operation." The initial capital of the Bank, fixed by the Bill at 15 million francs (£600,000) has already reached over 22 millions (£880,000), and it is believed that by the commencement of operations it will have reached 30 million francs (£1,200.000). The contribution from the State will be £400,000. The Bank is to be empowered to transact credit business with all the co-operative societies without distinction and to discount commercial bills given by them. The Bank will give preference to small credit transactions, speculative transactions being excluded. It will be managed by a council composed of representatives of the Ministry of Agriculture, the Treasury, Ministry of Public Works, the Bank of Italy, and of other institutions contributing to the capital, and will be under government inspection.

STATE AID TO AGRICULTURE IN NORWAY.

(From the *Journal of the Board of Agriculture*, Vol. XVII., No. 12, March, 1911.)

Some information as to the steps taken in Norway for the advancement of agriculture, dairying, and forestry, has been transmitted to the Board through the Foreign Office by H. M. representative at Christiania. The Central Administration is focussed in the Department of Agriculture, which in addition to a headquarters staff, maintains a number of officials who travel about the country and give advice on matters connected with agriculture, live stock, and dairying. They also assist the Central Administration in carrying out public works for the advancement of agriculture and dairying, and as they naturally come into close contact with the country population, they have every opportunity of ascertaining the conditions of the various districts. Proposals made by the Central Administration with respect to the carrying out of any new measures are, as a rule, sent to the officials concerned for any remarks they may have to make before these are submitted to the Storthing, but the Central Authorities have frequently appointed special committees of experts when questions requiring more detailed inquiry were being discussed.

In addition to this advisory staff there are several State establishments with special functions, viz., three chemical stations (including seed testing), two experimental stations for plant culture, three milk inspecting establishments, and three sheep breeding farms.

Aid to Agricultural Societies.—In each of the eighteen "amts" of the country there exists an agricultural society, and these societies are branches of the Royal Society for the welfare of Norway. The work of this Society has mainly consisted in taking the initiative in new measures for the advancement of agriculture. When arrangements made by the Society are found to be of practical advantage and are working satisfactorily, they are taken in hand by the Central Administration. The Society also undertakes special work, mainly of a scientific nature. The State grant to this Society amounts to between £1,667 and £2,222 per annum.

The State contributes towards the expenses of the local agricultural societies, an amount equivalent to the sums subscribed by the various districts. The agricultural society in Finmarken (the most northern "amt" in Norway)

forms, however, an exception, as it is supported entirely by the State. The State grants to the agricultural societies amount to about £11,000 per annum. In most of the six hundred communes in Norway there are agricultural associations which are subsidiary to the Societies.

Attached to the agricultural societies are a number of travelling officials, whose work it is to advise and instruct the country population in their country in regard to agricultural and kindred matters. The country agriculturists, of whom there are at present thirty-four, consequently act as advisers in questions regarding agriculture and domestic animals, and the country gardeners, who now number twenty, in those relating to horticulture.

In certain communes, district agriculturists and district gardeners have also been appointed. They are paid by the respective communes, and their work corresponds to that of the country officials, with the difference that their work is limited to one or two country districts. One-half of their pay is furnished by the State. Their number is at present thirty, of whom twenty-five are gardeners. These appointments are of comparatively recent date and only exist, as yet, in five counties.

There are also travelling instructors in cow-keeping, dairying, and pig-breeding, who are appointed by the agricultural societies or by private associations.

Of other organisations that have been formed to watch agricultural interests, may be mentioned the Norwegian Farmers' Association, to which farmers from all parts of the country belong. This association is not financially supported by the State.

Agricultural Education.—The agricultural schools have contributed largely towards the advancement of agriculture. An Agricultural High School was founded in 1897 with the object of providing instruction—on a scientific basis—in agriculture, dairying, forestry, horticulture, and surveying; there are, at present, about 150 students. The Budget of the school, which is financed entirely by the State, showed in 1910 an expenditure of about £23,000 and a revenue of about £11,000.

More elementary instruction in agriculture is afforded by seventeen agricultural schools belonging to different counties and by three private schools. Three-quarters of the expenses of the country agricultural schools are defrayed by the State and one-quarter by the respective counties. About 500 pupils are passed out of these schools every year. There are also four private agricultural schools, with an aggregate of about 150 pupils per annum.

There exist, also, twenty schools for domestic science, which are supported by the State and the "amts." The State grant for all these schools amounts to about £20,000 per annum.

In 1909 the State established a school for women teachers in domestic economy. About forty students a year pass through the courses at this school, and the grant in 1910 was about £1,660. For providing instruction in horticulture and dairying, the State has started seven schools for each subject. The State grants in 1910 were £1,740 and £1,600 respectively.

State Aid to Forestry.—About the middle of the nineteenth century it became apparent that the forests were being badly managed and were decreasing in value; men were therefore sent abroad, principally to Germany, in gradually increasing numbers to study the science of forestry. In 1857 a board of scientifically trained foresters was formed with the main object of managing the State forests. In 1863 a Forestry Law was passed. It does not restrict private owners in the use of their forest land, but it contains rules regarding the regulation of the rights of using forest land, the management of common land, and of forest land belonging to official residences, and regarding ecclesiastical endowments and other forest lands appropriated to Church livings or belonging to the State. The Law of 1893 contains regulations restricting the use of fire in woods and fields, and the Law of 1893 regarding the preservation of forests gives Local Councils the right of prescribing rules, which must be sanctioned by the King for the management of private forests. This was amended in 1908.

The staff of the Board that manages the State forests consists of four inspectors of forests, twenty-five forest bailiffs, and five assistant foresters, one forest valuer, and one assistant valuer, all trained foresters. There are also eleven tree planters and 451 rangers who assist in the management of the forests.

In twelve counties foresters are maintained, whose duty it is to advise private landowners in the treatment of their forests. The salaries and travelling expenses of these officials amount, at present, to about £2,778 per annum, one-

half of which is paid by the State; the other half is, as a rule, paid by the respective counties.

Forestry Education.—In addition to the forestry section at the Norwegian Agricultural High School, which has a three-year course, the State supports two elementary schools of forestry at a cost of about £1,100. The course lasts one year, and the number of pupils averages forty-eight; instruction is free.

There are likewise three county schools of forestry, the expenses of which are paid by the counties in question, but which also receive a grant from the State.

The State has also instituted several nurseries, which furnish the plants required for the State forests and supply private land owners with plants. Several seed farms have been laid out by the State, whence the seed is derived for the use of the State and for sale to private persons.

The Norwegian Forestry Association.—In 1898 the Norwegian Forestry Association was privately formed for the furtherance of forestry. This association has been strongly supported and has branches in all the counties. The State grant to the Society amounts at present to £6,256, this sum being used mainly in assisting private owners of forests to sow and plant trees and to drain swampy forest land. The grant from the State is paid out through the branch offices, which must procure a similar amount from the Local Councils or from private persons, as a contribution towards the cost of the work that is to be carried out. By the publication of a monthly Journal, and by issuing pamphlets from time to time, the Association endeavours to promote knowledge regarding the proper management of forests.

DENMARK.

A NEW BILL ON CO-OPERATION.

The May Number of the *Bulletin of Social and Economic Intelligence,* published by the International Institute of Agriculture contains the text and the introduction of the bill on co-operative societies, recently presented to the Parliament by the Danish Government, of which we think it well to give some account, in consideration of the importance that agricultural co-operation has attained in that country.

There are, in fact, at present in Denmark more than 3,000 agricultural co-operative societies, a very considerable number for a country of not more than two and a half million inhabitants.

It was through co-operation that the small and medium-sized Danish property was able to acquire strength and profit by the methods of extensive cultivation and wholesale trade. Thanks to it, meat, bacon, butter and eggs have become articles of very considerable export, the amount of which has risen, in only 30 years, from 30 million to more than 300 million crowns.

In Denmark there was no special legislation upon co-operation with the exception of a few provisions in favour of the cattle breeding societies and others intended for the development of agricultural credit. Even the present legislative movement is not due to any strongly felt need of the co-operators, but to the necessity of better regulating the limited liability societies; and, as a law had to be made for these, it was inevitable that the co-operative societies should be dealt with.

The new bill is very simple. It consists of thirty-six articles and tends to give uniformity as far as possible to the practice of the societies. It defines co-operation as essentially economic; co-operative societies are such as "without coming under the head of those provided for in article 1 of the law on limited liability societies are founded with the intention of obtaining for their members the implements or other articles necessary for their business, selling the produce of their members' industry, and otherwise favouring, but also by economic means, their economic interests."

The law prescribes the registration of the society in the registers of the co-operative societies. It leaves it to the societies to establish in their rules whether they may or may not do business with non-members. The number of members is unlimited.

Unless otherwise provided in their rules, the members are jointly and severally liable to the creditors of the society for the engagements made by it. Yet the creditors may take no measures against the individual members until after having tried in vain to obtain satisfaction from the society.

If the rules provide for limited liability, the amount for which each member is liable to third parties for the engagements of the society can never be less than 100 crowns. In any case the liability of members who have left the society continues for a year from date of their retirement. Other provisions regard the internal life of the society

and therefore are of less interest. In the last article it is said that the law is to come into force at the same time as that on the limited liability societies.

(*Summarised from the* Bulletin of the Bureau of Economic and Social Intelligence of the I. I. of A. *Year II, No. 5, 31st May, 1191.*

EDUCATION.

OBJECTS OF SCHOOL GARDENING.

(From the *School and Home Gardening Bulletin, No. 31, 1910, Bureau of Education.*)

The objects of teaching gardening in the schools are manifold. It is hoped through the agency of the school garden to introduce among the people the practice of home gardening. Gardening is a healthful pursuit; it makes stronger and better men and women, and will prove a permanent source of pleasure and profit to them; it develops in the pupils a sense of order and neatness, besides teaching appreciation of nature, regard for the property of others, self-reliance, respect for labour; it promotes habits of industry; it furnishes useful employment as well as amusement to children who would otherwise seek unprofitable diversion; it is a means to the pupil of acquiring manual skill and gaining some knowledge of soils, plants and insects.

Teachers should be required to inspect home gardens and report on them. This must be recognized as a part of the regular school work. Pupils should be required to plant and cultivate in a prescribed manner. Plants may be taken by children to their homes for resetting. Experience has shown that if pupils are given two or three choice varieties of plants they will themselves find enough others to make in all a very good assortment for the home garden. A school garden standing alone in a community, an isolated example of agricultural work, is only a beginning of what can be done. School gardening will stimulate and create an interest in the study of higher agriculture, thus paving a way for the solution of the many agricultural problems that confront us.

Divisions of the Work.

In every school in the Philippines some instruction should be given in plant culture, and in every school where the location will permit there should be a well-planned school garden.

The character of the work undertaken must be in some measure dependent upon the character of the soil and the extent of the site. It may embrace the following branches:—

1. The School Garden.

Here two different lines of work may be taken up: First, the making of such gardens as may be introduced in every home; second, the teaching of proper methods of producing staple field products of the locality through seed selection and intensive cultivation.

2. The Home Garden.

Much has already been done in introducing the cultivation of garden vegetables among the people. It is noticeable that markets now abound with vegetables in places where a few years ago they were not obtainable—a result that may be attributed to the emphasis placed upon gardening in the schools. Among the plants which succeed best in the Philippines are eggplant, okra, beans, lettuce, pechay, cabbage, pepper, radish, tomatoes, carrots, beets, ginger, peanuts, garlic, sincamas, ampalaya, native corn, camotes, gabi, and other hardy native vegetables that are grown in the locality of each school garden.

Frequently, where ground is limited at school, seed can be germinated in boxes and germinating beds; and young seedlings can be given to the children, who should be required to take them home, to plant them and to care for them, and to make, at certain intervals, reports upon the development of the plant.

Certain vegetable products are unfamiliar to Filipino households, and have not been so highly prized by them as they should be because the method of cooking the vegetable has not been understood. Where it is possible there should be co-operation between the classes in garedning and the classes in cooking. The bad physical results of an exclusive diet of rice and fish are not noticeable, and one object sought in the establishment of school gardening is an enrichment of food diet.

3. Plant Nurseries.

Where it is possible to have extended school gardens, useful plant nurseries should be established in which can be

grown the best varieties of plants, young trees and shrubs. These can be distributed through the community by means of the children, who will be required to care for them when they are taken to their homes. Plants which it is desirable to distribute in this way are maguey, kapok, rain tree, mulberry, sabutan, better varieties of bananas, pineapples, and papayas.

The few principles which are to be emphasized in this instruction are the same, no matter what branch of gardening is followed. They include a study of soils; use and care of tools; selection and preservation of seed; seed germination; methods of transplanting; insect enemies and their prevention; importance to the plant of tilth, watering, and manuring.

4. FLOWER AND ORNAMENTAL PLANT CULTURE.

Even where school grounds are very limited, or where there are no school grounds at all, the work may be begun in bamboo tubes and boxes. Essential principles of plant cultivation can be taught and fondness for such exercise can be developed, although the economic advantages of flower culture are not so apparent as those of vegetable culture. Among the flowers, shrubs, and vines which have been successfully cultivated in the schools are violets, cannas, four o'clocks, Brazilian creeper, aurora, antigonon (cadena de amor,) roses, hibiscus, ixora (santan,) bougainvillæ, allamanda, and jasamine (sampaguita).

SELECTING A SITE.

In school garden work the first thing to do is to select a suitable piece of ground. The site should be as near the school-house as possible; but area, water and good drainage are of prime importance, and when it is possible to get a better site by going a little farther away, it is best to decide in favour of the distant situation. The land should have a sufficient slope or fall to drain off during heavy rains. The surface of the garden should not contain depressions in which water will accumulate or stand. If such depressions exist, they should be filled in before trying to make a garden out of the piece of land. The garden should not be so high as to make the sinking of wells extremely difficult. Water is a prime necessity to all efforts at gardening, and difficulty in obtaining water forms an almost insurmountable barrier. There should be enough land in each school site for a neat school-house and with 20 meters or more clear land on each side.

The school house should never be crowded upon the edge of the school grounds, but should have room in front for decorative plants, shrubs, and trees, room on each side for play grounds, and room at the back for a vegetable garden.

PLANNING AND PLOTTING THE ENTIRE GARDEN.

Having selected and fenced the site the teacher is then ready to make a plan of the entire garden. He should find accurately the dimensions of his garden, and then calculate the possible size of each plot, allowing a plot for each pupil. Each pupil should be given an individual plot, because therein lies the key to successful school garden work. A community garden does not develop the idea of responsibility, and each pupil has a tendency to care less for the plants which another has shared in producing, with the result that responsibility is shirked, and there is a lack of interest with a consequent lack of industry. The idea of ownership and a respect for property rights come with the possession of an individual garden.

In making a plan of the garden, a path should be left around the outer edge 1 meter wide, a path should be between the ends of the plots 1 meter wide, and a path between the sides of the plots one-half meter wide.

Having made a plan of the garden, the teacher should draw it on the blackboard, and have each pupil make a copy of it. Then he is ready to take the pupils to the garden and have them separate the plots according to the plan, driving a stake at the corner of each individual plot. These stakes should be driven into the ground deep enough not to be displaced when the ground is spaded. A plot is now assigned to each pupil. The class should understand that the paths are to walk on, and that they should be kept free from weeds and grass. Each pupil should be required to bring manure for his plot, to plant the seed, to keep the ground cultivated and irrigated, and should be permitted to take home all of the vegetables that grow on his plot when they are mature, except one of each kind which must be left for seed.

Where the field cultivation of products of the locality is undertaken (as suggested on p. 10, sec. 1, under divisions of the work), half the total available space should be set side for the growing of a single staple product, as corn, camotes, bananas, or tobacco. Rice culture should not be attemped in this connection.

Preparing the Soil for Planting.

The pupil should first clean off all weeds and trash and then spade the ground as deeply as possible. After spading, a few shovelsful of well-rotted manure should be worked into the earth in each plot. The plot should be raked over, and all of the clods should be broken up. It is an excellent plan to go over the ground with the hands, crumbling the soil as fine as meal. The bed should be levelled up slightly higher than the rest of the ground, and should have the edges clean-cut and well-formed. Many err in building the garden beds too high above the level of the paths, as the soil dries out rapidly when raised too high. Rocks, bottles, and such stuff should be kept out of the garden.

Planning and Mapping the Pupil's Plot.

The teacher should have prepared a map of the pupil's plot. This map should be drawn with the utmost exactness, showing the individual plot, everything that is to be planted in it, the exact distance between the rows, and the exact distance between the plants. Everything on the map should be according to a fixed scale. One to twenty-five is a good scale; in this scale 4 centimetres on the map will equal 1 meter on the garden plot. The teacher should paste this map up in some convenient place in the school room, and should have each of the pupils make an exact copy of it on paper of a convenient size. This map in most cases will be too large to put on the page of a note-book. It may be folded and pasted in the back of each pupil's notebook. The teacher should see that each map is complete in details, and that all measurements are correct. The teacher should then tell the pupils how to use their maps—what each of the measurements on the map will be equal to on the garden plot.

The pupils should then be taken to the garden and shown how to make these measurements. They should measure off the distances according to the map, and should place a small stick where each plant or seed is going to be planted. After they have done this, the teacher should go around to each plot and see if all of them have been marked off for the plants according to the map. Do not tolerate inaccuracy. Do not permit any guessing or approximating of measurements. Anything that is worth doing at all is worth doing well.

Choosing Plants and Seeds.

The teacher must know what kinds of plants and seeds he is going to have the pupils plant before he makes his plan and map of the individual plot. In deciding what shall be cultivated in the school garden, first choice must be given to the plants in cultivation by the people in the locality. With these it will be well to grow others that are cultivated elsewhere in the Philippines. The seeds and plants for each student's planting must be so chosen that he will have work throughout the gardening season. If plants mature quickly, like pechay and radish, they can be planted between the rows of the plants that mature slowly, such as tomatoes and egg-plants. These quick maturing plants can be harvested before slower plants get large enough to shade them or large enough to hinder cultivation of both varieties.

The tasteful arrangement and proper planting of school gardens require much thought and study in order to insure satisfactory results. In choosing plants and seeds, study the nature of the soil and consider carefully the hardiness and mode of growth of the plants and their adaptation to that particular soil and climate.

Do not try to raise too many kinds. It is far better to grow a patch of fine, luscious tomatoes, that show by their size and flavour that they have received proper care and cultivation, than it is to have many kinds of plants in a half-starved condition. Begin your garden with a few kinds of plants, and then year after year increase the number. Good results will so be insured.

Keeping a Record.

In grades III and IV and in the intermediate grades each pupil should be required to have a note-book in which to record each step taken in everything he does. The teacher should examine the note-books often and see that they are kept satisfactorily.

The following record should be kept :—

Instruction concerning seeds, plants, and soil that the teacher has placed on the blackboard to be copied.

Maps of the entire garden and the pupil's own plot.

Notes on the kind of seed that were planted in the germinating bed, date of planting, time required for germination, date and size of plants when they were transplanted, method of cultivation, how often irrigated, enemies and methods in combating them, and the time and amount of harvest. A similar

record should be kept of the seeds that are planted directly in the garden without the use of a germinating bed.

Every teacher should keep a record of what has been done in gardening, what vegetables have been tried, whether they proved a success or failure, and the manner in which the plants were cared for. This should be known as the school record in gardening, and should be handed to each succeeding teacher.

TRANSPLANTING.

Before the seedlings are removed from the germinating bed they should be well sprinkled; but do not wet the ground where you are going to plant them until after they have been planted. This is very important and should be thoroughly understood before the pupils begin transplanting.

In transplanting great care should be taken so as not to injure the tiny rootlets. The young plants should be dug up, not pulled up. When they are dug up, plant them immediately. Do not let them wilt or the roots become dry before planting. When a plant wilts it is very hard for it to resume growth. In planting the seedlings first dig a hole with the hand deep enough for the plant, insert it, and see that the roots are in a comfortable position and that none of them are twisted or doubled. The young seedling or plant should always be planted deeper in the garden than it was when growing in the germinating bed. It is a good practice to set them out so deep that the earth will come up to the first leaves. The earth should be pressed down firmly around the plant, but care should be taken not to injure the stem of the plant. After the plant is set pour about one-half liter of water on it, so as to settle the soil snugly around the roots and to supply the plant with moisture until it develops more roots. After watering draw up the dry soil around the plant and over the wet spot. Every time the young plant is watered the wet spot should afterwards be covered with loose, dry soil to hold the moisture and to keep a crust from forming. When rather large plants are transplanted, it is best to pinch off some of the leaves, so that they may not evaporate water faster than the broken roots can supply it.

Transplanting should always be done toward evening or on a cloudy day, and the seedling or plant should be shaded with banana leaves or bunches of dry grass for about two days. Then all grass and banana leaves should be removed from the garden.

MISCELLANEOUS.

PERADENIYA EXPERIMENT STATION.

Minutes of a meeting of the Committee of Agricultural Experiments held at the Experiment Station, Peradeniya, on 13th July, 1911.

Present;—The Director, R. B. Gardens (Chairman), the Hon'ble the Government Agent, C.P., the Assistant Director, the Entomologist, the Hon'ble Mr. Edgar Turner, Messrs. Davies, Laycock, and the Secretary.

The Progress Report since the previous meeting was read.

Resolved that, in giving figures of the loss of soil through wash, the total loss since the inception of the experiment up to the previous meeting be appended.

Proposed by Mr. Turner and seconded by Mr. Laycock, that Mr. W. S. Coombe be approached as to his willingness to act on the Committee.

J. A. HOLMES,
Secretary, C. A. E., and
Superintendent, E. S. P.

PROGRESS REPORT ON EXPERIMENT STATION, FROM 11TH MAY TO 13TH JULY, 1911.

TEA.—Plots 141-143 and 151 and 152 have been tipped three months after pruning.

All the plots have been supplied, and as the weather was propitious, the plants are, with few exceptions, doing well.

The Manipuri Indigenous fields which were pruned in October, 1909, are still yielding heavily.

Many bushes of this Jat along drains and ravines died in the recent drought.

The Dadaps in Plot 149 were pruned on June 29th and yielded 2,346 lbs. of mulch.

CACAO.—The cacao still continues to blossom heavily, but the crop is not setting satisfactorily.

All the experimental plots have been supplied with young plants and shade.

The Dadaps in the young cacao have been cut, the yields for the four plots being 2,431, 2,180, 4,072, 3,437 lbs. respectively.

Rubber.—*Para.* The vertical method of tapping still continues to yield well.

In Plot 78 tapped with the Bowman-Northway No. 2 knife and pricker, a large percentage of the trees have developed most accentuated lumps.

Tapping has been discontinued on all trees finished on one side.

The opposite quarters and one-third methods are still in operation, and a basal herring bone has been started in Plot 82, row C.

Manihots. Tapping has been resumed on the Manihot varieties after a long period of wintering.

Coconuts.—The manurial experiments are being carried on and some extractions of oil have been made in conjunction with them. The manures, however, have not been sown for a sufficient length of time to allow of any deductions being drawn.

The young coconuts at Getambe have been supplied.

Green Manures.—The acre of *Tephrosia candida* in the young coconuts is being attacked by *Dactylopius virgatus*, which is itself being preyed upon by the larvæ of a ladybird beetle.

The following plots 1/100th of an acre have been cut since the last meeting :—

Leucaena glauca	132 lbs.
Indigofera hirsuta	105 ,,
Cajanus indicus	74 ,,

Oil Grasses.—It has now been found possible to plant out about a quarter of an acre of *Cymbopogon Martini* from the original plants obtained by Mr. Jowitt about eighteen months ago.

A further supply of *Polyneuros* has also been obtained from the Uva Patanas.

Distillations have been made from—

Cymbopogon Martni
do polyneuros
do confertifolius
do conflexuosus
Andropogon citratus
Lena Batu Pengiri
Maha Pengiri (Ceylon)
do do (Java)

Soil Wash Plots.—The losses since March 16th are as follows :—

Desmodium ..	213	Albizzia	748
Mixed Crotalarias..	784	Crotalaria incana ...	2,577
Dadap ..	1,700	Deep Forking ...	4,296
Bare soil ..	2,330	Crotalaria across slope .	499
Ipomea ...	495		

Fruits.—All the fruits with the exception of Mangosteems are thriving in the new plots.

Some of the plantains have been manured experimentally.

The results to date of manuring pine apples have indicated that a potash salt insures early fruiting, whereas any nitrogenous application appears to form luxurious leaf growth.

Neither farmyard manure nor superphosphate seems to make any appreciable difference.

General.—The present labour turnout is 20-30 % short, due chiefly to fever, which is especially prevalent amongst Sinhalese.

The boundary fence is more than half completed.

CEYLON AGRICUTURAL SOCIETY.

Progress Report LV.

Membership.

The following joined the Society since the General Meeting held on June 20, 1911 :—J. Littlejohn, H. O. Beven, G. S. Schneider, Stuart R. Cope, J. Brown, M.Valoopillai, N.D. Abeye Gunawardene, H. S. Stevens, D. Fairweather, J. B. Dickie, J. Hedde, H. E. E. Koch, E. A. Freeth (Superintendent, Stokesland Group), John Tilly (Jur.), E. H. Beling, Norman G. Westland, Henry Mason, E. S Jorgenson.

Staff.

It has been found necessary to engage two junior hands to assist in the typewriting and filing work, which is now quite beyond the capacity of the Head Clerk and his assistant. Sanction has also been obtained to employ additional Agricultural Instructors on probation.

Mr. N. M. Jayasuriya has succeeded Mr. S. R. Breckenridge, resigned.

Mr.S.Chelliah (Agricultural Instructor, Northern Province) and Mr. C. K. Sathasivam (Agricultural Instructor, Eastern Province) were given an opportunity of visiting some of the school gardens in the Western and Central Provinces so as to acquaint themselves with the methods of work, as these officers will be in charge of the gardens in their respective divisions.

Inspection Tours.

My own itinerary extended to Kegalla, Kurunegala, Negombo, Kandy, Dumbara, Kalutara, Veyangoda, Rambukkana, Weuda, Galagedara, Balakaduwa, Panadure, Horana, Anguruwatota, Padukka, and the neighbourhood.

Mr. N. Wickremaratnehas been devoting his time chiefly to work in the Kegalla District. He also visited Hakiri-

galla, Hakambiliyawa, Kehelwatugoda, and the experimental garden at Balalla.

Mr. S. Chelliah, besides touring in his district, gave special attention to the experiments for testing the value of seed and bulb cultivation in the case of onions, which is a regular crop in the north of the Jaffna peninsula.

Mr. L. A. D. Silva put in some work at the Bandaragama experimental garden, and made a circuit of ten days in the Ratnapura District.

Mr. C. K. Sathasivam has been engaged in supervising work in connection with cotton cultivation in the Eastern Province.

Mr. N. M. Jayasuriya, who has been a probationer for some time, and has succeeded Mr. Breckenridge, visited Tebuwana, Talahitiyawa, Anguruwatota, and Warakagoda. overhauled the Society's seed store, and attended to the distribution of seeds and plants.

Branch Societies.

Practical operations in the Provinces have been greatly hindered by the severe drought and its result in the outbreak of malarial fever. Shows and demonstrations have in most cases had to be put off for a more favourable season. In the Kalutara District three market shows were held at Kalutara South, Matugama, and Bandaragama during the month of May, and, in spite of adverse conditions, were attended with a good measure of success, the one at Wewita being the most successful.

Experimental gardens have been badly set back for the want of seasonal rains, but cotton weathered the drought at Balalla, and the fruit garden at Bandaragama has come out of it fairly well.

All-Island Show, 1912.

The following General Committee has been appointed to direct this big undertaking, which is to comprise all the rural industries of the Island, and be thoroughly representative of the Colony's agricultural resources :—

The Director, Royal Botanic Gardens, Peradeniya,
The Curators of Peradeniya and Hakgala Gardens,
The Government Agents of the nine Provinces,
The Assistant Government Agents of the several districts,
The Chairman, Planters' Association of Ceylon,
The Chairman. Chamber of Commerce.
The Chairman, Low-country Products Association,
Mr. E. B. Denham,
Dunuwille Disava,
Mr. A. J. R. de Soysa,
The Secretary, Ceylon Agricultural Society,
The Government Veterinary Surgeon,
Mr. M. Kelway Bamber,
The Maha Mudaliyar,
The Hon. Mr. Solomon Seneviratne,
The Atapattu Mudaliyar, Colombo,
Mr. C. M. Sinnayah, Mudaliyar,
Mr. A. E. Rajapakse, Mudaliyar,
Mr. J. D. Vanderstraaten,
Mr. L. W. A. de Soysa,
The Hon. Mr. Kanagasabai, and
Mr. F. Beven—

with power to add to their number.

The Special Committees deputed to deal with the different phases of work are constituted as follows :—

Finance Committee.

The Chairman, General Committee.
The Director, Royal Botanic Gardens.
The Chairman, Chamber of Commerce.
Mr. E. B. Denham.
The Hon. Mr. Solomon Seneviratne.
The Secretary, Ceylon Agricultural Society.

Catalogue Committee.

The Director, Royal Botanic Gardens.
The Curator, Royal Botanic Gardens.
The Chairman, Ceylon Planters' Association.
The Chairman, Low-country Products Association.
The Government Veterinary Surgeon.
The Hon. Mr. Solomon Seneviratne.
Mr. A. J. R. de Soysa.
The Secretary, Ceylon Agricultural Society.

Building Committee.

Mr. T. H. Chapman, Public Works Department.
The Director, Royal Botanic Gardens.
Sir Solomon Dias Bandaranaike.
The Hon. Mr. Solomon Seneviratne.
Mudaliyar A. E. Rajapakse.
The Atapattu Mudaliyar, Colombo.
Mr. W. A. de Silva.
The Secretary, Ceylon Agricultural Society.

The show will most likely take place in the latter part of June.

Paddy (Rice) Cultivation.

Demonstrations in the working of improved ploughs were continued, and in March a series of such demonstrations arranged by the Assistant Government Agent, Kalutara, were given at Matugama, Munamalwatta, Bellana, Bulatsinhala, Warakagoda, Madurawela,

Rerukana, Kindelpitiya, and Potuwila. The Assistant Government Agent specially requests that the demonstrations be pressed at the second, third, fifth, and eighth centres, and hopes that a circuit taking them in will be arranged for September.

The improvement, or rather the adaptation, of the plough to suit the conditions of the paddy cultivation continues to receive attention, and there is just now a very effective though light implement on the market priced at Rs. 6 for the ironwork only, the pole and handle costing a couple of rupees extra. It is sold by Messrs. Hunter & Co.

With the gradual adoption of steel in place of the wooden plough, there is every possibility of the harrow being taken up. A cheap type of the triangular harrow, as used in India, may be seen at the Government Stock Garden, and as the construction of the implement is quite simple, anybody can get one made for his own use for a few rupees.

Cotton.

The following extracts are taken from a report made under date March 7, 1911, by the Director of the Imperial Institute on samples of cotton grown in Ceylon during the 1910-11 season through the efforts of this Society :—

(1) Sea Island, grown in Dumbara. Lint fairly clean, soft, rather deficient in lustre, of cream colour with a slightly reddish tint. Yield of lint on ginning 27·3 per cent. ; yield of lint per 100 seeds 3·8 grams. The lint was very easily detachable from the seeds by hand. Strength uneven ; some portions weak. Length of fibre 1·5 to 2 in., but mostly from 1·7 to 1·9 in. Commercial value about 12¼*d.* per lb. ginned, with choice Georgia Sea Island at 15½*d.* per lb. This sample is rather more coloured than the best Sea Island cotton ; it is also less lustrous, and is of somewhat irregular staple.

(2) Caravonica, grown in Delft Island. This is rather harsh, lustrous, white to pale cream, and free from stains. Strength normal. Length of fibre from 1·1 to 1·5 in., mostly 1·2 to 1·3 in. Commercial value about 9½*d.* per lb., with middling American at 8·02*d.*, and good moderately rough Peruvian at 10½*d.* The lint is harsh and the staple short, but the cotton is of good quality, and would be readily saleable in the English market.

(3) Sea Island, from Hambantota. Lint rather dirty, soft, of good lustre and pale cream, with a few pale yellow and brown stains. Yield of lint on ginning 28·4 per cent. ; yield per 100 seeds 3·85 grams. Lint very easily detachable by hand. Strength uneven ; some parts very weak. Length of fibre somewhat irregular, from 1·7 to 2·0 in. Value about 11*d.* per lb. ginned, with choice Georgia Sea Island at 15¼*d.* The cotton is of good but rather irregular length. Its somewhat dirty condition and uneven strength and the presence of stains tend to reduce its value. It is important to see that no cotton bolls are mixed with seed cotton, as in ginning they would be broken, and render the lint "leafy."

(4) Sea Island, from Batticaloa. Lint soft, of good lustre, pale cream colour, with some yellow and brown stains. Some fragments of capsules were present. Yield of lint on ginning 30 per cent. ; yield per 100 seeds 3·24 grams. Lint very easily detachable by hand. Length of fibre irregular, from 1·3 to 2·3 in., mostly 1·8 to 2·2 in. About 11*d.* per lb. ginned, with choice Georgia Sea Island at 15¼*d.* The lustre and fineness as well as length of staple are good. Its comparatively low value is largely due to its irregular length and the presence of stained and immature fibre.

(5) Sea Island, from Chilaw. Lint soft, of good lustre, and of pale cream colour, with a few yellow and brown stains. Some fragments of capsules were present. Yield of lint 28·6 per cent. ; yield per 100 seeds 4·06 grams. Lint very easily detachable. Length of fibre 1·5 to 2·0 in., mostly 1·7 to 1·9 in. Strength generally good. Value about 13*d.*, with choice Georgia at 15¼*d.* Cotton of fair quality, and would be more valuable if free from stains and leaf.

(6) Caravonica, from Wellawaya. Ginned cotton clean, but harsh and rough, fairly lustrous, of cream colour, and free from stains. Strength fair. Length of fibre from 1·2 to 1·7 in., but mostly 1·3 to 1·5 in. Value about 10*d.* per lb., with middling American at 8·02*d.* and good moderately rough Peruvian at 10½*d.* This cotton is of good quality, and would be readily saleable in the English market.

In his general remarks Professor Dunstan says that nearly all the cottons appear to have suffered from the attack of insect pests, which probably accounts for the presence of stains and fragments of seeds and husks. It is important that attention should be given to this matter and suitable remedial measures adopted.

With a view to preventing the presence of immature fibres in the cotton only fully ripe bolls must be picked, so that several pickings may be necessary

to secure the best results. Different pickings should be kept separate.

The British Cotton Growing Association (through their local agents Messrs. Freudenberg & Co.) report as follows on another sample :—Sea Island, from Rajakadaluwa garden, stained, very leafy, value 8½d. Egyptian, from Matara, fair staple, value 9*d.* Larger consignments of these would naturally fetch better prices.

Seeds and specimen pods have been received from the Director of Agriculture, Bengal, of Garo Hill Cotton, remarkable for the size of its bolls, which could be seen at the Stock Garden.

The Agricultural Instructor, Northern Province, is getting 25 acres of land ready in Puneryn for planting this coming season.

The Agricultural Instructor, Central Province, in sending 4 cwt. of cotton raised in Dumbara to be ginned by Messrs. Freudenberg & Co., mentions that he expects about 35 acres in Gampaha district to be put under cotton, and asks that seeds be reserved for this area.

In the Eastern Province 25 acres at Sorikkalmunai and a similar area at Tampiluvil are being got ready for planting during the north-east monsoon.

Large private projects, both in the Eastern Province and the Hambantota District, are at present under contemplation.

A further report from the Director; Imperial Institute, dated March 8, 1911, on three samples of cotton grown at Tissamaharama, furnishes the following details :—(1) Mitafifi : Lint clean, rather harsh, lustrous, and somewhat uneven in colour, varying from white to very pale brown, almost free from stains. Yield of lint 31·7 per cent. ; yield per 100 seeds 5·33 grams. Lint easily detachable by hand. Strength generally good. Length of fibre from 1·3 to 1·6 in., mostly 1·4 to 1·5 in. The ginned value appeared to be equal to "fully good fair" brown Egyptian, which was quoted at 10½*d.* on February 3. This cotton is of good quality, and would be readily saleable in England. (2) Abassi : Lint clean, fairly soft, lustrous, and white, but rather stained. Yield 30·7 per cent. ; yield per 100 seeds 4·24 grams. Lint easily detachable. Strength uneven ; some parts very weak. Length irregular, from 1·0 to 2·2 in. The nominal value is put down at 9*d.* to 10*d.* ginned, with good Abassi at 13⅞*d.* per lb. The seed used was probably mixed with Sea Island, hence the unsatisfactory nature of the produce. (3) Sea Island : Lint clean, soft, of good lustre, white to cream, with occasional brown stains. Yield of lint 29·8 per cent. ; yield per 100 seeds 4 grams. Lint very easily detachable. Strength uneven. Length irregular, from 1·7 to 2·0 in. Nominal value 10*d.* to 11*d.*, with choice Georgia at 15¼*d.* The seed suggests a hybridized character resulting in a poor staple.

Reference was made in the last Progress Report to the variety of cotton known as "Cambodia," which has become popular in India. A sample of this cotton raised at the Balalla experimental garden was forwarded to the British Cotton Growing Association, through their local agents Messrs. Freudenberg & Co., and elicited the following report :—"I have to acknowledge the recepit of your letter of June 16, with reference to the sample of 'Cambodian' cotton grown at your experimental station at Balalla. The sample has been forwarded to us by Messrs. Freudenberg & Co., and we have submitted the same to one of our expert brokers, who reports as follows :—'Rather dull, staple 1⅛ in., strong, value 5·75*d.* The price of middling American is 7·74*d.* You will note that the value of this cotton is about equal to the price now being realized for middling American, and as the price of the latter is now fairly high, you would be in the best position to know whether it would pay Europeans to grow this class of cotton should the price of American cotton fall below 6*d.* per lb. It is certainly in its favour that the plant has stood the dry conditions prevailing, and that all the cotton ripened together. With cotton grown on European plantations, it has generally been our aim to grow cotton worth from 1*d.* to 2d. per lb. over middling American, and to obtain a production of about 200 lb. of lint to the acre ; but if with the cotton now sent the production is higher than the better class cotton, this of course would go some way to make up the difference in the price. We shall be sending to Messrs. Freudenberg & Co., some excellent Upland seed, which we have established in Nyasaland. This is originally an American variety, and has taken something like five years to establish. The result, however, has been eminently satisfactory, and the cotton grown from this seed has realized prices of from 2*d.* to 3*d.* per lb. over midding American. We will suggest to Messrs. Freudenberg & Co. that they hand you a small quantity of this seed to experiment with." Agricultural Instructor Wickremaratne reports that the Balalla plantation

is yielding a second crop (after the drought), which promises to be even better than the first.

Tobacco.

Mr. van Leenhoff's report on the tobacco experiment at Maha Illuppalama comes before to-day's meeting.

Reports on samples of the tobacco sent to Germany and India are disappointing.

The want of rain during April, May, and June greatly delayed planting in connection with the experiment being carried on by the Dumbara Tobacco Syndicate, but the latest reports are favourable.

Cigars made from native Dumbara leaf, properly selected and rolled under expert supervision, have been most favourably reported upon on the Continent.

Messrs. Freudenberg & Co. have about 2½ lb. of imported Alcasian tobacco seed, which they are prepared to give to members of the Ceylon Agricultural Society at 60 cents per ounce.

Fruit Culture.

During May, June, and July a large number of fruit plants, chiefly grafts, were distributed to members. In addition to the varieties usually imported from India, durian plants from Singapore, grafted mangoes from Jaffna, and budded Washington Navel oranges from Australia were also supplied. Grafting is being carried on through the Government Stock Garden, and grafts of the best local varieties of mangoes will be available for distribution next year.

The grafted plants distributed three or four years ago are reported to be fruiting in different parts of the Island. The June "Tropical Agriculturist" contains an illustrated account of the Hon. Mr. Seneviratne's fruit garden. Specimens of the Raspuri mango from this garden fully came up to expectations in regard to size and flavour.

Fruit growing is receiving special attention at the Bandaragama and Weragoda experimental gardens.

A small quantity of seeds of the Bell Apple (*Passiflora laurifolia*) was received from the Superintendent of Agriculture, Fiji.

There have been many inquiries for the Cherimoya, but those who are anxious to grow the tree do not realize that it has a very limited range. Mr. Macmillan (Curator of the Royal Botanic Gardens) considers that about 3,000 ft. elevation is the lowest limit of successful cultivation; while Hakgala is almost too high. Mr. John Tilly of Talawakele, who sent some good specimens of the fruit to the office, states that the Cherimoya does not thrive everywhere even in his district, and though he has succeeded, others have failed to grow it. He thinks it requires to be well sheltered from wind for one thing.

Investigations.

In forwarding the subjoined report on the wood and bark of *Terminalia glabra*, Professor Dunstan, in a covering letter says: "You will see that the material has some commercial possibilities, and I shall be glad to receive the large consignment asked for, in order that they may be more fully investigated." I may state that the section of kumbuk wood sent to the Imperial Institute was taken off a tree in the Victoria Park, where the soil is particularly poor in lime.

"The sample of the wood and bark of *Terminalia glabra* ('kumbuk'), which is the subject of this report, was forwarded to the Imperial Institute by the Secretary of the Ceylon Agricultural Society with letter No. 2,323 dated August 23, 1910. The ash of 'kumbuk' wood has been stated to be rich in lime, and it was desired to investigate this point at the Imperial Institute.

"As the barks of several of the *Terminalias* are rich in tannin and suitable for use as tanning material, it was also considered worth while to examine the bark of the sample from that point of view.

"The sample consisted of a small log about 18 inches in length, forked at one end into two approximately cylindrical branches, measuring respectively about 5½ and 4 inches in diameter. The cross section of the log was roughly elliptical and measured 7½ by 9¼ inches. The wood was hard, and consisted of a well-defined heartwood of irregular shape, surrounded by a pale whitish brown sapwood from 1 to 1½ inch in thickness. The log was covered with a smooth, thin, loosely adherent bark, grayish brown externally, and showing a tough fibrous fracture of bluish pink colour.

"*Wood.*—The wood when burnt yielded 1·60 per cent. of a white ash, which was found to contain :—

			Per Cent.
Lime	CaO	...	51·56
Potash	K_2O	...	12·97
Phosphoric Acid	P_2O_5	...	5·61

"These results show that the ash of kumbuk wood is, as reported, rich in lime, and if waste kumbuk wood is available in large quantities for burning, it could be utilized as a source of lime

for agricultural purposes. The crude ash will itself be useful as a manure, since it contains a large proportion of lime, together with some potash and phosphoric acid.

"*Bark.*—The bark gave the following results on analysis :—

	Per Cent.
Moisture	11·6
Ash	9·0
Tannin (by Hide powder method)	31·6
Extractive matter (non-tannin) ...	5·8

"The colour in a 1 cm. cell of a solution containing 0·5 per cent. tannin was 12·3 red, 26·4 yellow. The infusion from the bark deposited, on standing, a white sediment, which was found to consist principally of calcium oxalate. The bark produced a pale pinkish brown leather of stiff texture.

"The above results show that the bark of *Terminalia glabra* is a very promising tanning material, and if it is available in quantity, a representative sample of about 1 cwt. should be sent to the Imperial Institute for technical trials."

In this connection I may mention that I brought with me a sample of the ash of a burning kumbuk log I found near Akkaraipattu Resthouse (Batticaloa District) in March last and submitted it to the Government Agricultural Chemist, who has favoured me with the following analysis, which shows the percentage of lime in the ash to be 95·2 per cent. :—

	Per Cent.
Insoluble	0·4
Calcium Carbonate ...	95·2
Potash	3·1
Magnesia	1·3
Oxide of Iron	Trace
Sulphuric Anhydride ...	Trace

This is almost pure calcium carbonate, with a small quantity of potash and magnesia.

In a sample of ash sent by me from Dambulla in 1906, Mr. M. Kelway Bamber found 15·20 per cent. calcium oxide, 80·80 per cent. calcium carbonate. As the ash is easily burned to calcium oxide or quicklime, the proportion of lime would be about 97 per cent. It would be of interest to examine a section of the wood to see in what form the lime is deposited in the cells, also to estimate the actual amount of ash.

An interesting series of experiments with different crops has been begun at the Government Stock Garden, to determine the action of Jeye's fluid and toluene in the amelioration of soil conditions.

On referring the question of preparing an absorbent material from the *beach moss* of the Hambantota District, previously reported on by the Director of the Imperial Institute (*vide* Progress Report LIV.), Professor Dunstan writes under date July 8 that "the results of experiments do not indicate that a suitable material (a sample of which is enclosed) can be obtained from the moss." The report goes on to say that "it is lifeless to the touch, exceedingly weak and brittle, and does not appear satisfactory for surgical purposes. Its absorptive power is much less than that of ordinary absorbent cotton wool; it was in fact found to absorb only about three times its own weight of water under conditions in which absorbent cotton absorbed fourteen times its own weight."

The promised further report on the resin of *Gardenia latifolia* (previously referred to in Progress Report XLV.) is given below :—

"The sample of resin, which is the subject of this report, was forwarded to the Imperial Institute by the Secretary of the Ceylon Agricultural Society with letter No. 2,010 dated August 7, 1909.

"The sample weighed 2 lb., and consisted of irregular masses of greenish yellow resin, which was transparent in thin pieces. The resin had a very unpleasant odour. Many pieces of leaves and twigs were in the sample.

"The resin yielded on steam distillation 0·07 per cent. of volatile constituents, the nature of which could not be determined owing to the small quantity of material available. The resin, after having been submitted to steam distillation, was extracted with hot alcohol, and the resulting resin, now free from vegetable *dèbris*, was examined with the following results :—

	Per Cent.
Moisture	Nil
Ash	0·1
Melting point	70°C.
Acid number	92
Saponification number ...	167

Solubility in—

Alcohol	...Completely soluble in hot alcohol, but gives a slight deposit on cooling
Ether ...	...Partly soluble
Alcohol and ether	...Completely soluble
Benzene ...	...Partly soluble
Alcohol and benzene ...	...Completely soluble
Turpentine oil	...Partly soluble
Alcohol and Turpentine oil	...Completely soluble
Turpentine oil and benzene	...Partly soluble

"This resin from *Gardenia latifolia* appears to resemble in its properties the 'dikamali' resin yielded by an allied species, *Gardenia gummifera* (see Imperial Institute letter dated June 23, 1909). 'Dikamali' resin is still used to a considerable extent in native medicine in India, and was at one time used in veterinary practice in Europe, but its employment as a drug in Europe has long since ceased and is not likely to be revived.

"As regards the suggestion that the resin might be used for varnish making, it must be pointed out that the very unpleasant and persistent odour of the material would prevent its use as an ordinary varnish resin. It is possible, however, that the resin might be usefully employed in the Tropics for the preparation of an outdoor varnish to preserve wood from insect attack, and it might be worth while to have a few trials made in this direction in Ceylon. The resin could probably be used in solution in alcohol, or in a mixture of turpentine oil and alcohol as a 'spirit varnish' for this purpose."

Soil Examination.

A specimen of a curious black deposit, a foot and a half in thickness, found just below the sandy top soil in the Ja-ela district, was sent to the Agricultural Chemist, who reports that it is of the nature of a finely-divided loam, and that the reserve of humus and nitrogen is large, while there is a large supply of lime present, which keeps the soil sweet. Magnesia is present in good quantity, the potash in fair quantity, but the phosphoric acid is rather poor.

Specimens of concretions (said to be brought to the surface by land crabs) found on the fields near Karavetty in the Jaffna peninsula and submitted for examination to the Agricultural Chemist are said to consist of 47·5 per cent. calcium carbonate and 52·8 per cent. insoluble matter, with traces of magnesia and iron oxide.

Live Stock.

With a view to making a beginning in the improvement of the notoriously degenerate cattle of the Jaffna peninsula, I placed myself in communication with the Principal of the Coimbatore College of Agriculture, through whose kindness I was able to secure a young bull of the well-known Kangayam breed of cattle. In a letter the Principal says: "I consider him a typical Kangayam, and his sire, the farm bull 'Mapillai' (*see* 'Agricultural Journal of India,' V., Part IV.), has proved himself an exceptionally good stock-getter." The letter is accompanied by a sheet of particulars of the breeding of the young bull. The celebrated Kangayam cattle are not animals commonly found in Kangayam, but are specially bred by the Pattagar of Palaiya Kollai and a few others, who give very special care to the preservation of the strain. The cattle are strong, active animals, with compact bodies, particularly adapted for draft, and being of moderate size should prove suitable for crossing with our native stock.

Reporting on a recent invention of an identity mark (patented as "Electric") for cattle, the Government Veterinary Surgeon says that, though it is an improvement on the well-known method of fixing metal tabs on the ears, one must catch the animal to read the mark, which is a disadvantage.

In view of the poisonous character of certain Cape and Indian species of Crotalaria and their harmful effects on cattle, reference was made to the Government Veterinary Surgeon as to whether local species, so common as weeds, are known to do any harm. Mr. Sturgess reports that he has not noticed any disease in Ceylon similar to that observed at the Cape as due to the eating of Crotalaria. There is an affection with somewhat the same symptoms, but in addition there is a breaking out of abscesses in various parts of the body. This is traceable to an organism (*Streptothrix*), which gains access to the body through wounds, generally either a sore neck or the sores on the feet in hoof-and-mouth disease.

Plant Pests.

In reply to an inquiry as to what extent *Aspidiotus destructor* damages the coconut palm, the Government Entomologist reports as follows:—"*Aspidiotus destructor* does not appear to occur in sufficient numbers in Ceylon to cause any serious injury to coconut palms. Its natural enemies—Lady-bird beetles and minute parasitic Hymenoptera—seem to keep it in partial check. If, however, anything should occur to arrest these natural enemies, it is quite possible that the Aspidiotus might become a dangerous pest. The species was first described from Reunion Island, where it was said to be menacing the coconut plantations with complete destruction. The same insect was reported to be a serious pest of the coconut palm in the Laccadive Islands some fifteen years ago."

Replying to a query as to whether the Pocket Gopher or Pouched Rat occurs in Ceylon, the Government Entomologist writes:—"The 'Pocket Gopher' or

'Pouched Rat' (*Geomys bursarius*) belongs to a family of rodents that is confined to the new world. It is known to have a very complicated burrow. It is unlikely that our Ceylon rat constructs very branching tunnels, but I must confess that I have no accurate information on the subject. It is a question that could soon be settled on the spot by opening up several of the burrows. Our paddy-field rat is presumably the same species that has been giving trouble in the Federated Malay States, where the carbon bisulphide treatment is said to be successfully employed."

It may here be mentioned that carbon bisulphide employed by the Agricultural Instructors against field rats on the advice of Mr. Green has given very satisfying results. The burrows of these creatures are fairly complicated as ascertained in the Government Stock Garden.

Complaints have been received of the damage done to coconut gardens in Colombo city by the Rhinoceros beetle, as the result of suitable breeding places being provided for the pest by cattle manure depôts. The question of taking action against the owners of these depôts was referred to the Government Entomologist, who is good enough to report as follows:—"I fear that the owner of a coconut garden has no remedy under the Pests Ordinance against the owner of a neighbouring manure depôt, unless the district is proclaimed. Even then it would be difficult to enforce measures which would make the manure merchant's business impossible. If, as is possible, it can be shown that the manure depôt is injurious to public health from the sanitary point of view, the Sanitary Officer might be induced to move in the matter. I should fancy that a cattle manure depôt must breed and distribute an intolerable plague of house flies."

Lac Culture.

This subject was first brought to the notice of the Society by the Director, Imperial Institute, in a letter dated May 6, 1910. Professor Dunstan referred to stick and seed lac received from Baroda State gardens as having been collected from the rain tree (*Pithecolobium saman*), and suggested that as this tree was common in Ceylon, it would be worth while utilizing it as a host for the lac insect. He valued the seed or granular lac at 55*s.* to 60*s.* per cwt., London. The matter having been referred to the Government Entomologist, Mr. Green approved of an attempt being made to introduce *Tachardia lacca*, which up to date failed to reach Ceylon in a living state. In a letter received from the Imperial Entomologist for India, with whom I placed myself in communication, Mr. Maxwell Lefroy thought we should send over a man there to learn the business. Subsequently I was led to expect that Mr. Lefroy would visit Ceylon and give us the benefit of his advice on this subject, as well as on sericulture and apiculture, but his departure for Europe and his prolonged stay there suggested a further communication with his *locum tenens* (Mr. Bainbrigge Fletcher), which resulted in satisfactory arrangements being made for the despatch of an Agricultural Instructor to the Research Institute, Pusa, with a view to his undergoing practical training in lac culture during the September-October season.

Sericulture.

In May a Manchester firm wrote that they had been buying eri cocoons for some time past, and expressed their readiness to buy Ceylon-grown silk in quantity. The quotation made for cocoons was 1*s.* 6*d.* per lb. delivered Manchester, as per sample sent, which was of a low average quality.

Working as this Society has done in co-operation with the Imperial Entomologist for India, I consulted that officer, who wrote in reply that he would communicate direct with Manchester, but at the same time did not consider the offer very tempting, as the minimum price offered by the Bombay mills was Re. 1 per lb. Samples of the eri silk cloth made in India were also sent, and I am submitting these for inspection today. This information from Pusa was placed at the disposal of the Salvation Army. The latest developments at the silk farm are indicated in the following authorized communication by the Salvation Army:—"The Manager of the Salvation Army's silk farm has purchased from schools and villagers quantities of eri silk cocoons, and he is now in a position to buy from any one in Ceylon. The eri silk cocoons cannot be wound like mulberry cocoons, but there is practically an unlimited market for the former for cording and other purposes, and the Salvation Army is in touch with English and French firms who can purchase large quantities. One of the Salvation Army's silk schools in India sent a sample shipment to a Paris firm recently, which realized Rs. 500. There is a tremendous future before this silk in Ceylon, as our sample is superior to the samples sent by certain European firms. The experts to whom the samples

have been shown are high in praise of the material; it has remarkable strength, and is very good in other respects. There is money to be earned by the cultivation of the eri silk cocoons. A clean sample should realize from 75 cents to a rupee per pound to those who rear and sell. As castor leaf is easily picked up in the villages, the eri cocoons can be produced at a small cost. If the cocoon is white and free from stain and dirt, it will command the highest price in the European market. In order to produce a clean and white cocoon, our plan is to cut open the cocoon on the fifth day before the chrysalis removes its outer skin, which often causes a stain. Each cocoon is cut open with a pair of scissors and the chrysalis thrown out to the fowls. It is a simple operation, and can be done by children. This plan, however, may offend the prejudice of some. One of the great advantages of the eri cocoon is that one can allow the moth to escape without the necessity for destroying the chrysalis; where the above plan causes offence, the chrysalis may be allowed to escape. The stained cocoon will, however, fetch a lower price. What merchants in Europe object to is not as much the stain as the dirt, which easily attaches to such cocoons. In some markets the merchants usually allow 5 per cent. dirt in calculating the price of the cocoon; but the European merchants are very strict, and when they receive the cocoons, they have means by which they can calculate the percentage of dirt, and this they deduct from the price. Those who send eri cocoons to the Salvation Army school at Peradeniya should, as far as possible, see they are free from dirt. We separate the white cocoons from the brown. One reason why the white cocoons are preferred by the manufacturers is they are more easily dyed. The brown cocoons generally realize a good price. In order to secure the whiteness of the cocoons, the best plan is to place the worms in layers of crumpled newspapers in a basket for spinning their cocoons. We have found this very effective. We bale the cocoons according to their quality. Those that are white and quite clean go in one class. Those that are partially clean go in another. Those of bad colour go in a third. A trained silk reeler is due to arrive in Colombo from Bangalore in a few days. We have a considerable quantity of the mulberry dry cocoons ready to be reeled at Peradeniya. He has been trained to manipulate the new Japanese machine which arrived some time ago."

The informatien herein contained deserves to be widely disseminated, and goes to indicate that a village silk-rearing industry is not so remote a possibility as some are inclined to think.

Miscellaneous.

A correspondent raised the question whether paring and burning as practised and believed in by native cultivators cannot be replaced by some other treatment with the same advantageous results, to which the Organizing Vice-President replied: "The burning destroys the animal life that feeds on the nitrifying bacteria, and cannot in practice be replaced, though formaline can be applied (with great care) to produce a similar result." An experiment with a view to ascertaining the action of such disinfectants on the soil is referred to under the head of Investigations.

In reply to an inquiry, the Government Agricultural Chemist reports that the average nitrogen, phosphoric acid, and potash contents of coconut mill poonac are nitrogen 3·2 to 3·6 per cent., phosphoric acid 6 to 9 per cent., and potash ·25 to ·4 per cent.

Seed of *Lippia repens* recommended for lawns was received from Mr. Luther Burbank, but failed to germinate.

There has been considerable speculation as to the possibilities of introducing into the drought stricken areas of Ceylon the famous "rain tree" of Peru, which has been "written up" in some of the English magazines. A number of letters asking for seeds were received in the office from persons who were not aware that the tree credited with the property of producing rain was one of the common roadside shades, known in the vernacular as Ingasaman, and botanically as *Pithecolobium saman.* With a view to, if possible, ascertaining the grounds for the extraordinary reports about the tree, I placed myself in communication with a correspondent in Peru, who transmitted some interesting information. It may now be taken as proved that the tree possessing the properties claimed for it is a myth. What probably gave colour to these reports is the strong excretion of water, through hydathodes, as found in Fuchsia, Trophœolum, Alchemilla, and Colocasia, and most noticeable in tropical forests. According to De Candolle, *Cæsalpinia pluviosa* is the nearest example of a rain tree, possessing as it does the power of excretion to a very marked degree.

C. DRIEBERG,
Secretary,

August 14, 1911.

CURRENT LITERATURE.

ACTIVITIES OF THE HAWAII AGRICULTURAL EXPERIMENT STATION.

(From the *Philippine Agriculturist and Forester*, Vol. I., January, 1911.)

(*Concluded from June issue, page 551.*)

Shield budding can be set with speed and is applicable to seedlings most advantageously. In budding, bud union is possible only in an elliptical line between bark and the part adhering to the bud shield. By cutting a branch above a bud, the latter grows through the elongation of the cells, and if a new bud be inserted under the bark of that branch, provided union takes place, a homologous change in the direction of the grain is effected. While at times an adaptation of inarching is tedious, it is not very uncommon to have it serve successfully.

RICE.

In a fertilizer experiment with rice it was found that two hundred pounds per acre (222·2 Kg. per hectare) of a complete fertilizer having the composition:

6 per cent. nitrogen (3 per cent. organic as fish guano, 3 per cent. as sulphate of ammonia).

9 per cent. phosphoric acid (4 per cent. as water soluble, 5 per cent. as reverted).

10 per cent. potash as sulphate of potash, and having a net cost of $8·70 per acre (P43·50 per hectare) to which transportation and cost of application ($1·30 per acre or P4·25 per hectare) are to be added, gave practically as large yield of paddy as did greater quantities up to eight hundred pounds. Moreover, the results were approximately the same whether applied before the crop was planted or afterward.

A very interesting experiment has been performed to determine the effect of fertilizers on the composition of rice in its different stages of development. The following is an extract from Bulletin No. 21 on that subject:—

Ten plats of one-fortieth acre each were chosen and treated as follows: Three plats were not fertilized, forming, therefore, checks; the remaining seven each received different fertilizers, using the single elements on some, on others various combinations. Nitrogen, in the form of ammonium sulphate, was applied at the rate of sixty pounds of nitrogen per acre, phosphoric acid as superphosphate at the rate of forty-five pounds of phosphoric acid per acre, and potash as sulphate, at the rate of sixty pounds of potash per acre. No lime was applied, since previous tests failed to indicate its need. After thorough preparation the soil was flooded and left partially submerged for several days, after which the fertilizers were applied to the wet soil, thoroughly mixed with the same by hand, and then completely submerged with a very pure artesian water, in which condition it was maintained throughout the experiment, with the single exception of a period of about five days during the flowering period. The water at this time was shut off in order to hasten backward fruiting stems and insure uniformity in ripening.

The samples for analysis were gathered from each plat at three different stages of development of the plant. The first series were drawn forty-four days from the time of transplanting, or previous to the formation of flowers, transplanting having been done when the seedlings were from twenty to thirty days old; the second series, at the time of full flowering; and the third, at full maturity and normal harvest. All these samples were carefully uprooted to secure the entire plant, roots and all.

The experiment has been made with two different crops of rice, one with the spring, and the other with the fall crop. The following results have been drawn, as conclusions from the analysis of the samples obtained as above mentiond. The summary of the results is as follows:—

1. Fertilization with nitrogen, either with or without minerals, greatly increased the growth of the rice at all periods of its development. Minerals alone, or in conjuction with nitrogen, slightly increased the growth in the spring crop, but in the fall a corresponding decrease attended this application.

2. The percentage of nitrogen in the dry matter, at the first harvest of each crop, was considerably increased by nitrogen fertilizer, and was still further increased by the application of minerals in addition to nitrogen. The percentage of nitrogen in the mature plant was not materially changed by the fertilizers.

3. The dry matter from the plat fertilized with the complete fertilizer contained at every period of growth a higher percentage of potash than from the plats fertilized with nitrogen only. The application of minerals alone resulted in a decreased absorption of potash.

4. The percentage of phosphoric acid in the dry matter at the first period was influenced somewhat by the fertilizers. In subsequent growth no difference in the phosphoric acid content was found.

5. The percentages of calcium and magnesium in the total plant were not greatly different at the several periods of growth. The calcium at maturity is stored largely in the leaves, while magnesium migrates to the grain.

6. The hydrolisable carbohydrates vary inversely with the percentage of nitrogen absorbed.

7. The rice plant contains a high percentage of nitrogen, phosphoric acid and potash during early growth, which percentages become gradually reduced during later development.

8. Seasonal variations greatly influence the growth of rice, and likewise produce noteworthy differences in the composition, especially during early growth.

9. The rice plant, by the time it is two-thirds grown, has normally taken up about four-fifths of its maximum nitrogen and phosphoric acid and nine-tenths of its potash, and therefore fertilizers should be applied before planting or at an early period of development. In common with other cereals, rice demands readily available plant food in abundance during early growth.

10. Rice can take up what may be looked upon as an excess of nutrients if these be present in sufficiently large quantities.

11. There is no return to the soil through the roots of rice of nitrogen, phosphoric acid, or potash, and any loss of these substances that this plant may sustain is most likely traceable to the leaching action of rains and dews.

12. Reducing sugars were found in notable quantities in the rice plant at all stages of growth and were greatest at the first period.

13. Sucrose, while present as a trace at the first period, occurred in the stems at the second period to the extent of 10·38 per cent. At maturity this had been largely converted into starch.

14. Starch gradually increases throughout the growth of the plant, and at maturity is stored very largely in the grain.

15. The pentose-forming bodies constitute a large percentage of the carbohydrates of the rice plant at every stage of growth and reach a practical maximum at the flowering stage.

16. Cellulose occurs in large quantities in all parts of the plant, except the grain, and likewise almost reaches a maximum at the second period.

The above conclusions were drawn from a study of two different crops of rice, and while the experiments are preliminary, the results should be considered as probable, though not definitely settled. In the near future the practical bearing of these experiments will be set forth in a publication of more popular nature.

WORK OF THE ENTOMOLOGIST.

The most interesting feature in the work of the entomology department was the introduction and breeding of parasites against harmful insects. In the study of the pests attacking the cotton, fruit trees, and leguminosœ, employment of artificial remedies has been found impractical, at least on a large scale.

For the first time in the history of rice cultivation in the islands, this cereal was attacked by *Heliophila unipuncta*, serious losses having been reported from all the rice producing sections, the damage at two places amounting to from ten per cent. to sixty per cent. of the crop.

Outbursts of army worms have been reported from different rice-growing sections of the Philippines. One species has been found by members of the Entomology class of our College, attacking rice in Sta. Rosa, Laguna, and in Sto. Tomas and Tanawan, Batangas. Investigations already have been undertaken to determine this species.

A synopsis of the Hawaiian Aphidæ has been prepared. These small insects, although of great economic importance, have received practically no attention in the Philippines, as was also true in Hawaii. The Entomology Department there has realized their significance and the synopsis was the result of their work. A key to genera is given, and also the descriptions of twenty-one species, four of which are new. By means of these descriptions it is hoped that the Hawaiian farmers can easily identify the insects when they see them.

THE INFLUENCE OF MANGANESE ON THE GROWTH OF PINEAPPLES.

(*Press Bulletin No. 23.*)

In some of the pineapple soils in Hawaii there are certain black spots where pineapples do not grow successfully. In these spots the pines have a wilted yellow appearance, and the application of fertilizers and lime in conjunction with good tillage and drainage has not resulted in effectually overcoming the yellow appearance of the pines.

Samples of these black soils have been analysed and compared with samples of the red soils where pineapples make a thrifty growth. The following results were found :—

1. The black soils contain less acidity than the red soils.

2. Only one important difference has been found in the chemical composition of these soils, viz., in regard to the manganese content. The black soils contain many times as much manganese as the red soils. The black colour of those areas may in part be attributed to the presence of higher oxides or manganese, the presence of which is evidenced by the hydrochloric acid test.

3. The black and red spots are not separated by sharp lines of division, but rather gradually merge one into the other. There is, therefore, an intermediate area surrounding the yellow spots on which the pines show the yellowing to a lesser degree. With the view of determining whether the manganese likewise decreases in passing from the black soil to the red, several series of samples from different places were drawn at regular distances apart in passing from the black to the red soil. Analysis of these samples has revealed the fact that there is a close correlation between the degree of yellowing of the pines and the percentage of manganese in the soil. It has been shown further by the use of the guiacum and aloin tests that the plants grown on black soils are more vigorous oxidizing agents than the plants grown on the red soils. Bertand found that the ash of oxidizing enzymes contains considerable amounts of manganese, and that the addition of soluble manganese salts to the oxidase greatly accelerated their oxygen carrying power. All the results obtained above seem, therefore, to point out that the etiolated appearance of the pines grown on black soils is brought about by the increased activity of the oxidase due to the presence of large amounts of manganese. Actual oxidation of the chlorophyll seems to take place. An examination under the high power microscope of the cross section of the yellow leaves shows that for the most part the chlorophyll bodies have been destroyed.

USE OF CARBON BISULPHID FOR KILLING WEEDS.

(*Press Bulletin No. 20.*)

This chemical has been used with success for killing Crotalaria incana, lantana, guava, prickly-pear (Opuntia sp.) and Stachytarpheta dichotoma. The carbon bisulphid is poured on the stem at a point about six inches above the surface of the ground, On small stemmed plants like Crotalaria about a tea-spoonful of commercial bisulphid was poured, the amount being increased for larger plants, up to two table-spoonfuls for guava bushes, eight or ten centimeters in diameter. On most plants carbon bisulphid shows no effect until after the lapse of a considerable period on large guavas, sometimes two or three months. On others the effect is seen in from one to thirty days. When the trees killed by carbon bisulphid were dug out and examined their roots were found to be dead to the tip and their whole tissue discolored. Apparently, carbon bisulphid causes the death of plants by its freezing effect and also by a poisonous action as evidenced by the complete destruction of the roots to their tips, in some instances more than two meters from the point where the carbon bisulphid was applied.

In working with this chemical, it is always necessary for the workmen to keep to the windward in order to avoid the fumes, which, if inhaled continuously, may produce serious effects. It must be also remembered that the material is highly inflammable and should be protected from accidental flames. In some localities the difficulty of transporting containers may render the method entirely impracticable. On the other hand, the use of carbon bisulphid in the destruction of weeds has the advantage that young sprouts do not come up from the roots. The necessity of grubbing out all the roots is thus obviated. Under such circumstances it would merely be necessary to allow the weeds to stand until they are dead, after which the trunk and large roots would be removed, as is necessary in any case in clearing the land.

For obvious reasons, carbon bisulphid will never become the usual means of getting rid of weeds. But on a small scale, and specially in dealing with weeds which can grow from fragments left in the ground, it has a use in supplementing other methods. Regarding its effect upon the soil, the balance of the scanty evidence indicates that it is favourable; and this is explained by the recent observation at Rothamsted that it will completely destroy all protozoa in the soil, but not quite all the bacteria on which the protozoa feed. The nitrogen-fixing bacteria, freed of their enemies, multiply rapidly, and soon cause a great increase in the amount of available nitrogen.

USES OF ALGAROBA (TAGALOG, AROMA).

(*Press Bulletin No. 26.*)

As a forage crop Algaroba (*Prosopis juliflora*) is of great financial value. The pods are recognized as one of the most important grain feeds of the Islands of Hawaii, and are greatly relished by all kinds of live stock, including chickens. The quantities of pods produced by the algaroba forests cannot be estimated even approximately, for a large proportion of the pods are allowed to fall on the ground and are eaten by cattle, hogs and horses, without being previouly picked up. It has been estimated that approximately five hundred thousand bags of the beans are annually picked up and stored, particularly for feeding horses and cattle. On two or three estates at least fifteen thousand bags of beans are annually stored for this purpose.

Aroma, which is very like Algaroba, if not identical with it, grows admirably in the Philippines, where it can be found along sea-shores and elsewhere, and with a little labour and practically no expenses an excellent protein diet can be secured from it. It is time for our farmers to pay more attention to feeding their animals properly, and in these Islands where there is abundant forage stuff, there is no excuse for having labouring animals underfed.

There are other uses of Algaroba. Its wood constitutes one of the best sources of fuel, and the small branches furnish excellent material for making charcoal. The bark contains tannin, and is used in the Philippines as a dye stuff; its gum is suitable for use in varnish. The tree itself, being leguminous, is also a soil-maker of some importance. Moreover, the pods contain a high percentage of sugar and may be used in the manufacture of denatured alcohol and vinegar.

Review.

THE RUBBER-COUNTRY OF THE AMAZON.

BY H. C. PEARSON,
Editor of the India-Rubber World,
8vo., New York, 1911.

This is an account of the author's journey to the Amazon rubber country to attend the Rubber Congress, and is a witty and amusing book to read, though the amount of solid information to be gathered by any one really interested in rubber is not very great. There are, however, some important paragraphs here and there. For example, on p. 49 Dr. Huber's theory of the greater nerve of the Amazon rubber is quoted, and is the same which we overselves have arrived at, that it is due to the rubber drying under continuous pressure.

The author found less adulteration than is often supposed to go on: the commonest adulterant is also to be found in Ceylon, and is better therefore not mentioned.

By piecing together the paragraphs of information that are sandwiched between the entertaining personal paragraphs, one learns that a great variety of nuts may be used for smoking—not only the two usually quoted. This goes to show that the smoking—as smoking—is not the valuable thing, but that it is the coagulation with the acetic acid formed in the smoke, the keeping antiseptic with the creosote, and the drying under pressure.

The season lasts 3-6 months (the river rises from December to May) and tapping is daily or every other day. The yield per tree is doubtful, but the author inclines to think Markham's estimate of 3-7 lbs. a tree a season about the average.

The new railway (Madeira-Mamore) being constructed to avoid the falls on the Madeira will render a good deal of rubber country much more accessible than at present. The rubber country of Bolivia and Peru is also touched upon.

The use of special preservatives, and of Eastern Coagulation methods, has not been seriously taken up, though a few smoking machines, such as the Da Costa have been invented.

The book is worth reading, and is in no sense dull, but a very sprightly account of the author's experiences.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 20th June, 1911.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	70s a 75s
Zanzibar & Hepatic ,,	Common to good ..	40s a 72s 6d
ARROWROOT (Natal) lb.	Fair to fine ..	8d a 9d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ...	£6 15s a £6 17s 6d
Bombay bleached ,,	Fair to good	£7 10s a £7 15s
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 7s 6d
Madagascar ,,	Dark to good palish	£6 10s a £7
CAMPHOR, Japan ,,	Refined	1s 6d a 1s 8½d
China ,,	Fair average quality ..	15's
CARDAMOMS, Tuticorin	Good to fine bold	2s 6d a 3s
	Middling lean	2s a 2s 3d
Tellicherry	Good to fine bold ..	2s 6d a 3s
Calicut	Brownish ..	1s 9d a 2s 3d
Mangalore ,,	Med brown to fair bold	2s 2d a 3s 6d
Ceylon. - Mysore ,,	Small fair to fine plump	1s 7d a 3s 3d
Malabar ..	Fair to good ...	1s 8d a 1s 10d
Seeds, E. I. & Ceylon ,,	Fair to good ..	2s a 2s 1d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d
CASTOR OIL, Calcutta ,,	Good 2nds .	3¾d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	40s a 45s
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts	Good to fine quill	6½d a 1s 5d
per lb. 2nds	,, ,,	5¾d a 1s 4d
3rds	,, ,,	5d a 1s
4ths	,, ,,	4½d a 8½d
Chips, &c..	Fair to fine bold	2¼d a 3d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1s 2d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	6½d a 7d
Stems ..	Fair	3d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	70s a 113s
Native	Good ordinary	
Liberian ,,	Fair to bold	60s a 65s
COCOA, Ceylon Plant. ,,	Special Marks	70s a 85s 6d
	Red to good	63s a 69s
Native Estate ,,	Ordinary to red	40s a 62s
Java and Celebes ,,	Small to good red	25s a 77s
COLOMBO ROOT ,,	Middling to good	25s a 30s
CROTON SEEDS, sift. cwt.	Dull to fair	47s 6d a 55s
CUBEBS ,, ,,	Ord. stalky to good	165s a 175s
GINGER, Bengal, rough ,,	Fair	35s nom.
Calicut, Cut A ,,	Small to fine bold	80s a 85s
B & C ,,	Small and medium	60s a 70s
Cochin Rough ,,	Common to fine bold	40s a 45s
	Small and D's	40s
Japan ,,	Unsplit	36s
GUM AMMONIACUM ,,	Ord. blocky to fair clean	40s a 67s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£15 a £16
	,, ,, little red	£12 a £14
	Bean and Pea size ditto	75s a £12 10s
	Fair to good red sorts	£7 10s a £10
	Med. & bold glassy sorts	£5 a £7
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d
Turkey sorts ,,		45s a 60s
Ghatti ,,	Sorts to fine pale ...	20s a 42s 6d nom.
Kurrachee ,,	Reddish to good pale ...	20s a 30s ,,
Madras ,,	Dark to fine pale ...	15s a 25s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£17 a £18
	com. stony to good block	25s a £13s
KINO	Fair to fine bright	9d a 1s 2d
MYRRH, Aden sorts cwt	Middling to good	55s a 60s
Somali ,,	,, ,,	50s a 52s 6d
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	35s a 40s
pickings ,,	Low to good pale	12s 6d a 27s 6d
siftings ,,	Slightly foul to fine	20s a 22s 6d
INDIA RUBBER lb.	Fine Para bis. & sheets	4s 11
	,, Ceara ,, ,,	4s 6d
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	4s 9d a 5s
	Fine Block ..	5s
	Scrap fair to fine ..	3s 10d a 4s
Assam	Plantation ..	3s 6d
Rangoon	Fair II to ord. red No. 1	2s 9d a 3s
	,, ,,	2s a 2d 9s

	QUALITY.	QUOTATIONS
INDIARUBBER.*(Contd.)*		
Borneo	Common to good	1s 6d a 2s 2d
Java	Good to fine red ..	2s 3d
Penang	Low white to prime red	1s 8d a 2s 6d
Mozambique	Fair to fine red ball ...	3s 6d a 3s 10d
	Sausage, fair to good ..	3s 6d a 3s 9d
Nyassaland	Fair to fine ball ...	3s 4d a 3s 8d
Madagascar	Fr to fine pinky & white	3s a 3s 2d
	Majunga & blk coated ..	2s 1d a 2s 6d
	Niggers, low to good .	8d a 2s 10d
New Guinea	Ordinary to fine ball ..	2s 6d a 3s 6d
INDIGO, E.I. Bengal	Shipping mid to gd violet	3s 2d a 3s 8d
	Consuming mid. to gd.	2s 8d a 3s 1d
	Ordinary to middling	2s 5d a 2s 10d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	None here
MACE, Bombay & Penang	Pale reddish to fine	2s 6d a 2s 8d
per lb.	Ordinary to fair	2s a 2s 6d
Java	,, ,, good pale	2s a 2s 6d
Bombay	Wild	4d a 5d
MYRABOLANES, cwt	UG and Coconada	4s 6d a 5s
Bombay ,,	Jubblepore	4s 6d a 6s 3d
	Bhimlies	5s a 6s 6d
	Rhajpore, &c.	4s 6d a 5s 9d
Bengal ,,	Calcutta	4s a 5s 6d
NUTMEGS— lb.	64's to 57's	10d a 1s 2d
Singapore & Penang ,,	80's	6½d a 7d
	110's	5½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17s 6d a 20s
NUX VOMICA, Cochin	Ordinary to good	8s 6d a 9s 6d
per cwt. Bengal	,, ,,	7s a 7s 6d
Madras	,, ,,	7s a 8s 6d
OIL OF ANISEED ,,	Fair merchantable	4s 10d
CASSIA ,,	According to analysis	3s 3d a 3s 7d
LEMONGRASS ,,	Good flavour & colour	4d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2d a 1s 4d
CITRONELLE ,,	Bright & good flavour	11d
ORCHELLA WEED—cwt		
Ceylon ,,	Fair ...	10s
Madagascar ,,	Fair ...	10s
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair ...	4¾d a 5d
Ceylon ,, ,,	,, to fine bold heavy ..	4¼d a 5d
Singapore ...	Fair	4½d
Acheen & W. C. Penang	Dull to fine	4d a 5d
(White) Singapore ,,	Fair to fine .. .	7⅛d a 8d
Siam ,,	Fair	7½d
Penang ,,	Fair	6½d
Muntok ,,	Fair	8d
RHUBARB, Shenzi ..	Ordinary to good ..	1s 2d a 2s 6d
Canton ..	Ordinary to good ..	10d a 1s
High Dried..	Fair to fine flat ...	8½d a 9½d
	Dark to fair round ..	5½d a 7½d
SAGO, Pearl, large ...	Fair to fine	18s a 19s
medium ..	,, ,,	17s a 18s 6d
small ..	,, ,,	13s a 15s
SEEDLAC cwt.	Ordinary to gd. soluble	52s 6d a 72s 6d
SENNA, Tinnevelly lb.	Good to fine bold green	4½d a 7d
	Fair greenish	2½d a 4d
	Common speckyand small	1⅛d a 1½d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ...	62s 6d a 150s
Bombay ,,	,, ,, Nom.	45s a 150s
Mergui ,,	,, ,, ,,	£10 2/6a £12 2/6
Manilla ,,	Fair to good ..	£7 7/6 a £13 5s
Banda ,,	Sorts	25s a 30s nom.
TAMARINDS, Calcutta...	Mid. to fine bl'k not stony	10s a 12s
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	10s a 33s
	Pickings ..	8s a 23s
TURMERIC, Bengal cwt.	Fair	20s
Madras ,,	Finger fair to fine bold bright	25s a 27s
Do. ,,	Bulbs	16s 6d
Cochin ,,	Finger ..	19s
	Bulbs ...	14s
VANILLOES— lb.		
Mauritius ... 1sts	Gd crystallized 3½ a 8½ in	14s a 19s
Madagascar ... 2nds	Foxy & reddish 3½ a ,,	13s a 15s 6d
Seychelles ... 3rds	Lean and inferior ..	12s 6d a 13s
VERMILLION ..	Fine, pure, bright	3s
WAX, Japan, squares	Good white hard ...	41s

THE SUPPLEMENT TO THE

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MESSRS. LEVER BROS.' COCONUT VENTURES.

MR. WICHERLEY'S STATEMENT REFUTED.

In an article reproduced in our July number Mr. Wicherley stated that Messrs. Lever Bros., after sinking thousands of pounds in trying to work the copra trade of the Solomon Islands direct with England, decided early in the present year to cut their losses and leave the Solomon Islands and its copra trade severely alone. This, Mr. Wicherley added, was because the cost of collection was found to be enormous, often amounting to over £50 per ton when copra could be purchased in England at £22 per ton delivered. As a result Messrs. Lever Bros. were now turning to the palmforests of the Belgian Congo in the endeavour to obtain supplies.

A very different report has been given us by Mr. Wallace Westland who has visited some of the properties and has frequently met Mr. Fred. Wernham, Messrs. Levers' Manager in the South Seas. The latest innovation Mr. Westland saw was a tank steamer for transporting the Coconut Oil direct home. The oil is pumped from vats into the steamer's tanks. On the voyage home it solidifies in the colder northern clime and at the port of destination steam is introduced to the tanks to melt the oil, so that it may be pumped out.

Mr. Westland states that he never saw finer coconuts than on one 700-acre estate included in Mr. Wernham's charge. This was an exceedingly fine property with excellent trees, yielding heavy crops. Since then Mr. Wernham has planted up a 2,000-acre block of good flat land and this, too, is doing splendidly, while further developments are still proceeding. This gives an entirely different complexion to Mr. Wicherley's statement: but perhaps he was confusing Messrs. Levers' coconut ventures with their attempt to grow rubber in the South Sea Islands which was not attended with success.

CEYLON'S RAINFALL.

8½ YEARS OF 'A DRY CYCLE OF 11 YEARS.'

Now that intelligence has come of the fears prevailing in Bombay on account of a deficiency of the monsoon rainfall—and of the dire consequences, if it should continue—we are reminded how clearly this year so far has demonstrated that we are still in the "dry cycle." The local rainfall statistics long ago supported the view that Ceylon was liable to cycles of eleven comparatively "dry years" succeeded by eleven "wet years." The late Mr. R. B. Tytler was the first to draw attention to this circumstance, at a time his material dependence lay on his estate in the Doombera Valley, when the experience or absence of a good fall of rain on the coffee bushes, at a critical point in the season, made a difference of at least £10,000 to him. The matter was fully worked out in columns and carried on in our Ceylon Directory statistics, until the question came under the notice of Sir J. Norman Lockyer, when out in Ceylon and India, during the Eclipse Expedition in 1871, and he connected the variation in the Ceylon rainfall and weather with the sun-spot cycle. Be that as it may, it is a fact that while our average annual rainfall for Colombo for 41 years is close on 83 inches (82·91), the fall for the past 8 years has been below the mark, going down in 1909 and 1910 so low as 58·41 and 66·13 inches respectively; while for the first half of 1911 Colombo has only got 20·82 inches or little more than half the average for that period. The last year of copious rainfall was 1902 which gave 118·70 inches and then the following years recorded as follows:—

	inches		inches		inches
1903	=79·39	1906	=71·55	1909	=66·13
1904	,, 76·62	1907	,, 70·62	1910	,, 57·30
1905	,, 65·66	1908	,, 50·41	1911(½)	,, 20·82

It will be noted that only the first year (1903) came near the average. Between the 12 years 1891 and 1902 (inclusive) there were only 4 years below the average—three very little below and only one (1892) so low as 60·83; while 8 years gave 119·03, 89·67, 92·23, 101·06, 82·73, 103·11, 83·68 and 118·70 inches respectively. Looking at these figures and the succeeding record of a series of 8½ lean years, are we bound to anticipate two more years—1912-1913—before the comparatively dry cycle of eleven years comes to an end? There is some cause for this expectation; and yet who dare say that we may not, possibly, have "the unexpected" to happen even during the rest of the present year, with a wet closing of the South-West, and a very rainy North-East Monsoon? In the meantime, we heartily trust that the Simla predictions of immediate further rains throughout India during the rest of July may be realised, and we hope, a wet August may follow. For India, the risks from a deficient rainfall are serious and momentous to a degree never realised in this favoured, sea-girt, island between the two monsoons.

THE INTRODUCTION OF PARA RUBBER INTO THE MALAY STATES.

CREDIT GIVEN WHERE CREDIT IS DUE;

AND CORRECTION OF A MISTAKE UNWITTINGLY MADE IN THE LECTURE OF NOVEMBER LAST BEFORE THE ROYAL COLONIAL INSTITUTE ON "CEYLON, THE MALAY STATES AND JAVA."

An apology is due to our distinguished and esteemed correspondent Henry N. Ridley, Esq., F.R.S., C.M.G., &c., for the delay in publishing a letter and extracts he was good enough to send us some time back, and which at the time were duly acknowledged, with thanks, and the promise of early attention.—On the other hand, some delay was required to enable a search to be made among the references and authorities upon which certain remarks offered in last November's "Lecture" about "Ceylon, Malay States and Java" dwelling on the very early days of "Rubber" in the Malay States. But this was more difficult than we expected, owing to the misplacing of a box of papers, recently recovered; and only now have we been able to deal with the matter properly. The fact is that in our preparation, our dependence had to be mainly on the previous Papers by such officers as Mr. (now Sir) Frank Swettenham, Sir Wm. Treacher, Mr. W. E. Maxwell and Mr. (now Sir) Hugh Clifford for the early history and administrative progress of the Malay States; and better authorities generally could not have been found. But, on the point of the inception and early days of Rubber Cultivation in Perak and other States, there was really more particular and accurate information in a direction not available to the Lecturer at the time. This was the "Agricultural Bulletin of the Straits and Federated Malay States" and in the issue for January, 1903, we now find Mr. Ridley had given the "History of the introduction of Para Rubber into the Malay Peninsula." This we had read at the time, but had forgotten seven to eight years later, while "Historical Notes on the Rubber Industry" in the number of the same periodical for June, 1910, had not reached us. The Magazine, unfortunately, was not available when we were putting the lecture together. Sir Hugh Low, undoubtedly, deserves great credit for his special interest in the early rubber plants in Perak; but the Lecturer was wrong in inferring, from certain passages which were quoted that he was the first to introduce Hevea plants or to begin the cultivation. Indeed Sir Hugh Low himself, never made such a claim; nor would he do so. The absolutely correct account of the very beginning of the INDUSTRY in RUBBER in Malaya, which has become so important for the FEDERATED MALAY STATES, is that formally given by Mr. Ridley in June, 1903, and again (in reviewing Dr. Willis's "Agriculture in the Tropics") in June, 1910; and this has been briefly summarised in the letter of 2nd April last as follows:—

Botanic Gardens, Singapore,
April 12th, 1911.

John Ferguson, Esq., C.M.G., &c., Ceylon. Dear Sir,—It is with some surprise and much regret that I read in your lecture to the Royal Colonial Institute on "Ceylon, the Malay States and Java," a reiteration of the myth as to the introduction of Para rubber and its cultivation in the Malay Peninsula. It is an entirely erroneous story which I disproved long ago in the "Agricultural Bulletin" (a copy of which I send you.) Sir Hugh Low did *not* introduce the Para rubber tree at all from Ceylon or elsewhere. The plants were sent to the Botanic Gardens, Singapore, from Kew, and some were planted in Perak by Mr Murton of the Botanic Gardens, Singapore, some in Sir Hugh Low's garden and others (which Low never saw) in other parts of Perak. But it was not from the descendants of these trees that the Peninsula was planted up to any large extent; but from the trees propagated by Mr Cantley in the Botanic Gardens, in Singapore, whence in reality the whole industry sprung. Of the part played by Sir Frank Swettenham in this I have not fully dilated in my articles on the industry, and foundation of the cultivation. He did not believe in the value of the cultivation till he left Singapore and a few days before that reprimanded me for wasting time on cultivating the tree. Previously when at length I had worried the planters into trying this cultivation, a Dyak was told to ascend to the top of one of the old trees of Sir Hugh's date and get some rubber. The Dyak did so and came back and said there was none. Soon after, down came over 100 of the finest trees in the Peninsula. Mr. R. Derry then attacked the rest of the trees and took out a quantity of first class rubber and sold it in London at a good price, and stopped the reaction against rubber which set in immediately the story was published that an official had proved the Para tree valueless.

Since the Hevea cultivation has proved a success all kinds of people have come to the front and calmly annexed the credit in spite of the

fact that they never did anything at all in the matter; and it eventually became necessary for me to expose their impostures which I did in the "Agricultural Bulletin." Still a story once started takes a great deal of time to catch up, especially if it happens to be quite mythical.

You are right about the seeds sent to Ceylon in about 1883. We sent a lot as our trees fruited first. We were then (1883-1884) distributing to Borneo and other parts of the world.

It was to Messrs Murton and Cantley that the F.M.S. owe their estates and not to Sir Hugh Low *nor* Sir Frank Swettenham. Sir Hugh was indeed a great agriculturist and must rank next to Raffles as all round the greatest man we have had here. If he had remained here, agriculture would have been a century a ahead of its present day status; but much of his work was destroyed after he left.

I hope you will some time see your way to correcting the "Low" myth, which I suspect arose out of jealousy between the F. M. S. and the Straits Colony; but it is difficult to find out who started it.

The whole story from documents, letters, archives and actual knowledge on my part is published in the Bulletin and is indisputable. I am also publishing a pamphlet on the history of the industry for the Rubber Exhibition, which may help to kill the myth.—Yours sincerely,

HENRY N. RIDLEY.

To this we append from the "Agricultural Bulletin of the Straits and Federated Malay States" January, 1903:—

THE HISTORY OF THE INTRODUCTION OF PARA RUBBER INTO THE MALAY PENINSULA.

As there has been a good deal of confusion as to the history of the introduction of the plant into the East, the following history may be of some interest. In a letter dated 17th April, 1878, from Sir William Thiselton Dyer, then Secretary to Sir Joseph Hooker at Kew Gardens, he writes: "On 4th June, 1873, we received from Mr Markham some hundreds of seeds, obtained from Mr Jas. Collins; of these seeds less than a dozen germinated and six of the plants so obtained were taken by Dr King, Superintendent of the Botanic Gardens, Calcutta, in the same year to India. The climate of Calcutta did not prove very favourable to the Heveas which require the conditions of growth met with in hot and moist tropical forests. It was therefore decided on consultation with Mr Markham that in the event of more Heveas being raised and sent out from Kew they should be received at the Botanic Gardens, Ceylon, which should then be regarded as the depôt for supplying young plants to such parts of India as were suited for its growth.

On June 14th, 1876, we received from Mr. Wickham about 70,000 seeds of which about 4 per cent germinated. On August 9th, we despatched 1,919 plants raised from these seeds in Wardian Cases in charge of a gardener. Of the whole consignment 90 per cent reached Dr. Thwaites in excellent condition. On August 11th 50 plants were sent to the Botanic Gardens, Singapore. Owing to the delay in payment of freight these plants all perished.

On June 11th, 1877, 22 plants were sent to the Botanic Gardens, Singapore.

In October of this year Mr. Murton, Superintendent of the Gardens, Singapore, planted himself 9 Heveas and 1 Castilloa at the back of the residency in Kwala Kangsa. Mr. Low reports, "They were brought here in October last by Mr Murton and planted at the back of the residency and are growing very well. They were quite small when they arrived here, but the Castilloa is now (July 26th, 1878), 5 feet high with branches of equal length and the Heveas vary from 4 to 8 feet and are growing vigorously." In a subsequent report dated February 3rd, 1879, Mr. Low writes 'the Heveas are now 12 to 14 feet high. They take to the country immensely. The Castilloa is a large tree 10 feet high with branches 5 feet long."

At the same time that these were planted some Para, Castilloa and Ceara rubbers were also planted at Durian Sabatang (Teluk Anson), but it appears they were washed away by a flood shortly after.

In a later letter from Sir Hugh Low to the Royal Gardens, Kew, dated December 11th, 1896, he writes "As I am writing I should like to mention that the Hevea Braziliensis, which having received from Kew through Singapore, I planted at Kwala Kangsar in Perak, grew magnificently and fruited I believe two or three years before those of Ceylon. I distributed the seeds to various places in the neighbourhood and they are now to be found in Mr Hills' Coffee Gardens in various parts of the Peninsula and several places in Perak. When Mr Swettenham was at home in the summer I enquired of him as to their condition and found they were not thought to be of any value as some Dyaks had tapped some of the largest trees and found that scarcely any juice exuded from them." This unfortunate statement seems to have deterred Perak planters from paying any attention to Para rubber for some time. Sir Hugh Low obtained some seed from somewhere in 1882 and gave it to Mr Wray who planted it at Kwala Kangsar. This may have come from the old trees there, for Sir Hugh Low sent seed (50) from Perak to the Singapore Gardens; the same year seeds were distributed from the Singapore Gardens, the first recorded being sent to the Bishop of Sarawak.

This entirely disposes of the statements by Wray* and others that the first seeds or plants introduced into Perak were introduced by Sir Hugh Low in 1882. In fact almost every plant of Para rubber in the Malay Peninsula was derived from the Botanic Gardens, Singapore, and these directly or indirectly through Ceylon from the Royal Gardens, Kew.

In 1877, Murton who had planted the young trees received from Kew as above mentioned, in the Upper Garden, (removed) to a more suitable locality in the new Economic Gardens and the trees on the right side of the plate are believed to be these plants. In his report for 1881, Mr. Cantley writes "the tallest Hevea (in the gardens) is now 25 ft. tall and 14 inches round the base. These trees commenced to fruit in 1882."

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* Notes on Rubber-growing in Perak (Thaiping 1897.)

Seeds were later received in large quantities from Ceylon, and when the Kwala Kangsa trees began to fruit Sir Hugh Low sent seeds from them back to the Singapore Gardens for distribution.

Although the plant grew so well, planters could not be induced to take it up, and owing apparently to a report that it produced no rubber, the few people interested in rubber turned their attention to Castilloa and Ceara rubber. But practically with the exception of Mr. T H Hills' estate, there were no plantations of Para rubber till Tan Chay Guan commenced to plant in Malacca.

In 1897, however, the high price of rubber and the low price of Coffee stimulated the interest of planters and a rush was made for the seeds. At the same time planters in all parts of the tropics sent for seeds and plants and attempted to grow the plant everywhere with varying success. In many countries it seems to have proved a failure, the climate being unsuitable.

In the Malay Peninsula it appears to have been more successful than in almost any other country both in rapidity of growth and production of rubber and the only thing to be regretted is that planters did not take up the cultivation ten years ago.

And finally, from the issue of June, 1910, of the same Magazine, we extract from a Paper entitled "Historical Notes on the Rubber Industry," as follows :—

When history is written, even of such a subject as the story of discoveries and invention connected with the rubber industry, it is advisable that it should be not only complete but accurate. We are led to this observation by reading certain articles in the recent numbers of the "India Rubber Journal" and "India Rubber World" and Dr. Willis' "Agriculture in the Tropics." In these papers the incompleteness and inaccuracy lie in the account of the so-called re-discovery of wound-response, which it was first claimed was an original discovery by Messrs Willis and Parkin, in 1899; but later as a re-discovery of a phenomenon known to the Amazons seringueiros and some other points. The discovery that the second and later tappings of a rubber tree produce a greater flow of latex than the first is one that no one can possibly overlook who taps a tree consecutively for a few days running and notes the result.

In the "India Rubber Journal" of March 21, 1910, an account is given of an article in "Science Progress," by Mr Parkin, who visited Ceylon in 1899, but unfortunately did not visit Singapore, where he would have found not only a much larger collection of rubber-producing plants, and a much greater number of Para rubber trees of good size, but also that experiments in rubber tapping had been carried on for ten years previously, and that the phenomenon of wound-response had been known for many years.

One is glad to see that he mentions the work done by Dr. Trimen, and the interest he took in the possibilities of profitable cultivation of *Hevea Braziliensis*; for Dr. Trimen, has not of late years received the share of credit for his work in this matter and in other agricultural, horticultural and botanical work that was due to him.

On my first coming out to the East in 1888, I stopped for a month on the way with Dr. Trimen at Peradeniya, and had an opportunity of seeing the fine Para Rubber trees at Heneratgoda, and talking with Dr. Trimen about their tapping and the possibilities of a future rubber industry.

On my arrival at Singapore I found in the Economic Gardens more than ten times as many Para rubber trees than there were at Heneratgoda. These had been planted by Mr Cantley, who, like his predecessor Mr Murton, had foreseen a future for rubber. These trees, however, had been much overgrown with secondary growth at which no one will wonder when I say that the vote for keeping up the Economic Gardens, about 120 acres, which were almost entirely overgrown with dense secondary forest, only paid for ten coolies and a mandor. As soon as was practicable the rubber ground was cleared of undesirable trees and shrubs, and I and my assistant commenced to examine into the tapping of the rubber trees. In these years we had annual Horticultural Exhibitions in Singapore, the first of which, after my arrival in 1888, was held in 1889. Besides the exhibition of plants and flowers we always showed specimens of new or interesting economic products grown and prepared in the Botanic Gardens, such as tea, coffee, fibres, etc., and always with them were samples of Para rubber from the old trees in the Gardens. I am not sure if there were any on view in 1889, but there certainly were in 1890, when the Duke and Duchess of Connaught visited the Show. The trees were tapped in the herringbone method and the latex collected in cigarette tins and allowed to coagulate naturally in the tins without the use of acid. The tins were square, and had a hinged lid which could be closed over the cup to prevent the falling in of dirt as described in the Bulletin of 1897. These tins were bought by the dozen in the bazaar, and used for a long time. One of these small blocks of rubber is preserved in the museum of the Botanic Gardens, Singapore, and though quite black it is firm, clean, sound and good though nearly 20 years of age. A piece of rubber made in a saucer, one of the first "biscuits" (made 1893) is also sound and good. But most of these samples were distributed to various institutions and to persons interested in it who sent them to their firms at home.

Needless to state we discovered what is now called "wound response" shortly after we commenced tapping in 1889, but from some Brazilian seringueiros who visited the Gardens later, I found that it was well-known to them, so did not record it as an important discovery on my part. At that time the preliminary tapping before taking the latex on the second day was called "Calling the rubber," and when samples of rubber were required for any purpose a man was sent to "call the rubber" two or three days beforehand. At this date, twenty years since I commenced tapping the rubber trees, I cannot remember when I actually discovered the wound-response for myself.

Many planters and agriculturists, and Dr. Trimen himself, visited the Gardens in these early days, and the advantages of rubber as a crop was urged on them. They were shown the trees, system of tapping and specimens, and the

necessity of "calling the rubber" before collecting in bulk, was explained to them, and they often carried away with them samples of the prepared rubber. Many of them came from Ceylon or had intimate relations with Ceylon. All this was going on some years before Mr Willis or Mr Parkin came to the East at all, or had seen a rubber tree. Mr Wright, in talking of Mr Willis' discovery of "wound-response," (this word indeed seems to have been invented by Mr Parkin or Dr. Willis, but it does not occur in Parkin's first account of his experiments) says that it is of great practical importance in rubber cultivation, and also of great botanical interest. I fail to see where the great practical importance comes in, at present; we knew of it all along, and the chief value of its knowledge was that in early days a few ignorant people who attempted to tap a tree one day, and did not find the rush of latex at first that they expected, thought, till they knew of it, their trees were useless. Should we, however, find out the real meaning of it, we might gain some knowledge of the functions and physiology of latex which could not fail to be of value, but at present we are not much wiser today on this subject than we were in 1890. Mr. Parkin's original paper, published in Ceylon Circular June 12-14, 1899, was one of considerable value, although many of the facts were already known to those who had been studying rubber for some years. Unfortunately, in those early days of Singapore, it was almost impossible to get any agricultural research work published in any reasonable time. We had to depend on the services of the Government Printing Press, which was so full of work that papers took any time from six to eighteen months to get printed, and we had, as before remarked, too small a vote to spend a cent on printing from our funds.

[Then comes the real story of the first "Biscuits" or "Pancakes."—J.F.]

BISCUITS.

Mr. Willis, in his Agriculture in the Tropics, gives so odd an account of Mr. Parkin's invention of Biscuits that it is worth quoting: "Not only did Mr. Parkin work out the wound-response and thus change what appeared to be only a moderately remunerative industry into a very profitable one, but he also worked out the way of coagulating rubber into 'biscuits' the form in which the bulk of the cultivated Para Rubber has hitherto appeared on the market, (for the sheets of Malaya are simply larger biscuits). Instead of allowing the latex to run down the tree, and thus become dirty, coagulating into a mass of dingy black rubber in a coconut shell, he showed that it could be collected in little tins placed one under the other, cut and then mixed together and coagulated with a certain amount of acetic or other acid." This discarded system was the one adopted by Dr. Trimen in 1888, and Ceylon had made no further progress till 1899. The coconut shell system was never, I need hardly say, used in the Botanic Gardens, Singapore, but the herring-bone system of tapping and the cigarette tins and saucers were adopted in 1889, just ten years previously, and specimens of the rubber so made had been freely distributed to many parts of the world, long before Mr. Parkin made his great invention. There is absolutely no suggestion as to making biscuits, sheet or any other definite form in his paper at all!

The following is Dr. Trimen's description of his process. The method followed was to smooth the surface by scraping off a little bark to a height easily reached and then to make with a ⅝ inch chisel numerous shaped incisions at the foot of the tree; coconut cups were fastened with clay and the milk conducted to them by little ridges of clay. Most of the milk dried on the tree in tears. The tapping was done in the afternoon.

The real story of the "invention" of biscuits, or "pancakes" of rubber as they were called, is this: When, in the Botanic Gardens, Singapore, we began to tap regularly we desired to get a form of rubber which dried more rapidly and kept a cleaner, brighter colour and sought about for a more suitable form of vessel to set the rubber in. As no funds were available for anything expensive and any specially made vessel, however simple, was too costly for our experiments, we hit upon the common enamelled iron plates which are extensively sold in Singapore, and being in common use by natives were very cheap. These were found quite satisfactory, and the form that the rubber took in them was that of the well-known biscuit. Biscuits of rubber were made and most of them given away to various persons interested in rubber, and very likely found their way even to Ceylon, in about 1897. Sheet was made soon after, at first in a photographer's developing tray of fairly large size, which we happened to find in Singapore. In any case I cannot find anywhere that Mr. Parkin ever made or thought of a single biscuit. He gives in his paper no suggestion as to this whatever, beyond saying that commercial rubber can be freed from moisture and putrefaction by drying it in thin sheets. Mr. Curtis writes in his annual report for 1898, about rubber taken from the Penang trees: "A sample was submitted to Messrs. Hecht, Lewis and Kahn, for valuation, who reported it as beautiful rubber, very well cured, worth to-day 3/3 per lb." This was tapped and collected in tins which he describes nearly two years before Mr. Parkin discovered the method of making it in this manner, and it was by no means the first sample sent home to the rubber dealers from the Straits.

Rubber grown by Mr. Tan Chay Yan, the first practical rubber planter in the Colony, was exhibited at the Malacca Show in 1898. This was the first Para rubber shown for competition from the Straits. It was grown in Malacca at Bukit Lintang.

In Mr. Derry's report of Government Plantations in Perak, 1897, he says:—"Many trees have been tapped and a report on the work submitted. The rubber obtained is not yet sufficiently smoked for sending home, but samples have been valued in Mincing Lane at 2/8 and 3/- a pound and considered equal to the best Brazilian produced rubber and also worth 1/- a pound more than that usually sent home from the Straits. He gives also a number of figures of returns from trees of various ages." He sent home in 1899 the first large parcel of Para rubber from the Malay Peninsula; it realised £61 1 6.

Willis' "Agriculture in the Tropics," which we do not intend to review here, only gives an account of Tropical Agriculture as seen in Ceylon. Economic plants not cultivated or of importance there are scrappily and often inaccurately described (e.g. Sago Ipecacuanha.) It is apparently not intended for a general work on Agriculture in the tropical regions, and this is doubtless the reason why the work with Para rubber done in the Straits Settlements is entirely ignored. Unfortunately it is clear from the journals which quote from it that the readers are under the impression that the account of the development of the rubber industry in Ceylon, as given by Mr. Willis, gives the whole history of the rise of the industry in the East, which is far from being the case.

Practically nothing was done in Ceylon to push the industry or to experiment with the Para rubber trees from 1888 to 1897.* Even the stock of trees at the Gardens seems to have been hardly increased. Meanwhile, at Singapore, as far as was possible, everything had been got ready for the development of the future industry. A large number, about 1,400 trees, had been planted to supply the stock of seed, a good many dispersed to various parts of the Peninsula, to District Officers and planters. Experiments in tapping in various forms had been made, wound-response had been re-discovered, block and biscuit rubber had been made, specimens exhibited at exhibitions, distributed to various persons and institutions interested in planting, and sent to rubber dealers who had valued it at the top price of the market (1896), while a number of experiments in growth and flow of latex had been tried. There is still in the Botanic Gardens museum a biscuit dated 1890. It was coagulated without acid and is now quite hard and stiff, though still light in colour, a pale yellowish white. Those specimens dated 1893 and 1894 are black and are now showing signs of deterioration, but still fairly sound and elastic.

It will thus be seen that as a matter of history the Botanic Gardens of Singapore were just about ten years ahead of Ceylon when Mr. Parkin first conceived the plan of making respectable looking rubber instead of the messy stuff only known there till 1899. There is nothing whatever to show however that good saleable samples of rubber were made in Ceylon as early as 1899, either published or in the correspondence with Ceylon Botanic Gardens in our office.

Though Mr. Parkin was unable to visit the Singapore Gardens, he obtained a good deal of information as to our work by correspondence, as he sent a long list of questions in 1899, on the subject and asked me to perform certain experiments for him. Mr. Willis writes in answer, April 15, 1899:—"Mr. Parkin was so busy finishing off his experiments, that he had no time to answer your kind letter about rubber in Singapore before leaving for England and he asked me to do so. We are very much obliged for the information..........Your trees yield much better than ours, though poorly compared with those at Para, and I am inclined to think that Para rubber planting will never be a big or *lasting* industry in the East." It must be remembered that rubber was at that date very low in price and that we were all tapping the trees very lightly and with much caution not being sure that the plant would stand the amount of cutting it gets nowadays.

Since writing the above, a copy of the "Tropical Agriculturist" has come to hand giving Mr Parkin's paper in "Science Progress" in full. He modestly does not mention himself by name as the discoverer of wound-response and the art of making clean rubber, but gives the credit of the "discovery" to Mr Willis and his scientific assistant. As in Mr Willis' various works on the history of Para rubber industry no allusion is made at all to the work of the Singapore Botanic Gardens. In Willis' "Agriculture in the Tropics" the only allusion to the work done in Singapore is: "But little interest was taken in the trees for about 20 years (*i.e.* from about 1884) except by the heads of the Botanical departments in Ceylon, Java and Singapore." Now all that was done between 1888 and 1896 in Ceylon was to tap a single tree once a year. In Java nothing at all appears to have been done as the trees in Buitenzorg were too small and wretched to offer any prospect of their being ever likely to be worth cultivating. About 1894 Dr. Treub and Mr. Wigman, of the Botanic Gardens, Buitenzorg, came to visit the Singapore Gardens, and wished to see the rubber trees. On the first sight of the younger ones Dr. Treub turned to Mr. Wigman and said, "Wigman, did you ever see such trees?" "No," said Wigman, "nothing like them." I was surprised but found that the Buitenzorg trees were, though as old, quite small and not at all encouraging in appearance. Dr. Treub took the greatest interest in all economic plants, but evidently up to that date had not thought of Para rubber as being a suitable cultivation for Java,* and as far as I can gather no experiments or records of observations were made in Java till after 1899. Mr. Willis does not even mention Dr. Trimen's work, which deserves credit as he was the first, I believe, to tap the rubber tree in the East, and to record his results.

Meanwhile, the Botanic Gardens, Singapore, was at work from 1889, and was laying the foundation of the industry and indeed had submitted saleable rubber of first class quality to experts, and had proved that the industry would pay well before Mr. Willis had ever seen a rubber tree. Surely in an account of the rise of the industry purporting to be a history of the Agri-

* So far back as 1883, Dr. Trimen was anxious to see planters experiment with rubber and to us, personally, he urged the publication of a "Rubber Planter's Manual" at the *Observer* Press and gave help to the little book then issued;—later editions followed in 1888, 1890, 1900; and in some of his Annual Reports Dr. Trimen advocated the cultivation. By March 1898, 750 acres were planted in Ceylon by planters, and by May 1901, there were 2,500 and by middle of 1904 as much as 11,000 acres. The Export from Ceylon rose from 2,792 lb. in 1898 to 41,798 lb. in 1908.—J. F.

* That was also the effect on our mind by his personal remarks when we visited Buitenzorg in September, 1908.—J.F.

culture of the World, this work should not have been entirely ignored. It was known to most of the planters of the East Indies and to many, I am sure, in Ceylon.

It would be too long to detail all the discoveries and inventions made in the Straits Settlements and F.M.S. connected with the industry. They include most of the systems of tapping (except the spiral, which proved a failure); the crepe machines, the forms of rubber known as biscuit, block, crepe and sheet, the wound-response, actual returns of the tree, best method of packing seeds, and the pests, *Fomes*, *Diplodia Hymenochoete*, *Termes Gestroi*, etc., and methods of dealing with them. To Ceylon we must credit the worm-machine (invented after the crepe machine), spiral tapping, the pricker and Biffen's centrifugalizer and the Northway knife. Honour to whom honour is due, the Botanic Gardens of Ceylon have produced valuable papers by Trimen, Bamber, Petch, Green and others and Parkin's paper though anticipated was a useful piece of work.

The following extracts from correspondence from Sir William Thiselton Dyer will show to a small extent how far Singapore had progressed in rubber research before Mr Parkin wrote his paper in 1899.

Sir William Thiselton Dyer writes in answer to the Director of Gardens in December 1, 1896. —"I am glad Para rubber is going ahead, I always said the Straits would be the place for it."

June 19, 1897.—"There is a tremendous boom in India-rubber planting. Most of the schemes are simply insane. Your result from a nine year old tree is very good."

December 28, 1898.—"Para rubber seems at last fairly established in the Native States, Derry's report is very promising. 'Beautifully prepared' is only a broker's term. It means that the rubber is clean and free from excessive moisture. I can't imagine why your Para rubber is only quoted at 3/3. I can only suppose it is because it was not smoked."

The reader is also referred to the June number of the Bulletin, 1899; but probably by the time he has read this account he has had had enough evidence laid before him that the art of making saleable rubber by tapping into tins and preparing the resulting latex in a clean and pure form of Para rubber had been invented in the Singapore Gardens some years before Ceylon had got beyond the mud and coconut-shell stage and that the discovery by Mr. Parkin in 1899 of the method of making clean rubber was anticipated by nearly ten years, and was perfectly well-known as was wound-response, to hundreds of people in the Straits Settlements and other parts of the East long before Mr. Willis or Mr. Parkin ever came to the East at all.

As previously remarked history, if worth writing at all, is worth writing accurately and completely, and the stories of the origin of the industry as given by Messrs. Willis and Parkin are inaccurate and misleading.

While on the subject of the history of the rise of the rubber industry in the East, it may be as well to print here some letters dealing with the subject in its very early inception, as we think they will be found of considerable interest;

Royal Gardens, Kew,
17th April, 1878.

SIR,—I am desired by Sir Joseph Hooker to acknowledge the receipt of your letter of the 6th April, transmitting an extract from a letter from the Government of India, and requesting the transmission to Ceylon of certain stocks of Hevea and Castilloas.

In replying to this letter, Sir Joseph Hooker thinks it will be convenient that I should review the whole operations of this establishment in effecting the introduction of India-rubber plants into India.

1. Hevea brasiliensis—Para Rubber. On 4th June, 1873, we received from Mr Markham some hundreds of seeds obtained from Mr Jas Collins. Of these seeds less than a dozen germinated and six (6) of the plants so obtained were taken out by Dr King, Superintendent of the Botanic Gardens, Calcutta, in the same year to India. The climate of Calcutta did not prove very favourable to the Heveas which require the conditions of growth met with in hot and moist tropical forests. It was, therefore, decided in consultation with Mr Markham that in the event of more Heveas being raised and sent out from Kew, they should be received at the Botanic Gardens in Ceylon, which should then be regarded as the depot for supplying young plants to such parts of India as were found to be suitable for its growth.

On June 14th 1876, we received from Mr Wickham about 70,000 (seventy-thousand) seeds, of which about 4 per cent germinated.

On August 9th, we despatched 1,919 plants raised from these seeds to Ceylon in 38 Wardian cases, in charge of a gardener. Of the whole consignment 90 per cent. reached Dr. Thwaites in excellent condition. All subsequent accounts have been satisfactory, and no difficulty is found in multiplying the plants by propagation to any extent.

On August 11th, 50 plants were sent to the Botanic Gardens at Singapore. Owing to the delay in the payment of the freight these plants all perished.

On August 23rd, 50 plants were sent direct to Major Seaton in Burmah. These reached their destination in bad condition.

On September 29th, a further supply of 100 plants was taken out to Dr. Thwaites, in charge of Dr. Duthie, Superintendent of the Botanic Gardens, Saharunpore. These reached Ceylon in good order.

On June 11th, 1877, 22 plants were sent to the Botanic Gardens, Singapore. The Superintendent reports that the climate appears suited to their growth.

On September 7th, 37 plants were sent to the Botanic Gardens in Mauritius, and reached the destination in good order.

On September 15th, 100 plants were again sent to Dr. Thwaites and 50 to Calcutta, in charge of Mr. Morris, Dr. Thwaites' assistant. Both consignments reached their destination safely. Of those sent to Calcutta a portion was immediately despatched by Dr. King to Major Seaton, with whom they are now doing well. It appears, therefore, that while upwards of 2,000 plants are safely established in Ceylon, smaller parcels are also growing in Burmah, Calcutta, Mauritius

Rubber Growing on Waste Land.

Land which is not fit for growing Hevea rubber trees or Coffee, Cocoa, Tea, etc., can be made to yield good profits by cultivating the new varieties :—

Manihot Dichotoma Ule for Clay Soil

Manihot Piauiensis Ule for Sandy Soil

Both of these varieties also grow well in dry regions with very good results. For trial orders we send 10 lbs. (about 3,700 seeds) by parcel post, including postage, on receipt of £3. Always state full postal address. Bags of 135 lbs. at the rate of 3/6. per lb. delivered in Hamburg. Orders may be booked through your European Agents or sent direct to us.

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and Singapore. The plant is now therefore to be regarded as definitely established in the East Indies, and with ordinary horticultural skill, in the course of a few years, in raising an indefinite number of young plants.

Beyond keeping a small stock for occasional distribution it does not appear that this establishment is called upon to take any further steps for the propagation and distribution of this plant to India.

I should add that on November 21st, 1876, Mr Cross reached Kew with about 1,000 young plants brought direct from South America. Only about three per cent. of these plants survived, and they, therefore, contributed but little to our resources for distribution.

2. Castilloa elastica—Rubber of Central America. Sir Joseph Hooker has already stated, in a letter to the India Office, dated April 1st last, what has been done with respect to this kind. I quote the following passage: "The cuttings brought home by Mr Cross were received on October 3rd, 1875 (The 7,000 seeds received previously failed to germinate). Steps were immediately taken to establish and propagate them, and on August 9th, 1876, 32 healthy plants were forwarded to Dr. Thwaites, 28 of which he subsequently reported were well established in Ceylon and doing well."

On September 15th, 1877, a further consignment of 24 plants, was transmitted to Dr. Thwaites in charge of Mr Morris. A few plants have also been sent to Mauritius and Singapore. The propagation of this species will for the present be continued at Kew, and during the ensuing summer a further small consignment will be sent to Ceylon. Cuttings do not strike so readily as those of the Hevea, and the multiplication of plants is therefore necessarily slower.

3. Manihot Glaziovii—Ceara rubber. Mr Cross brought to Kew, on November 21st, 1876, seeds and cutting of this plant from which a stock of 55 individuals was eventually obtained.

On June 11th of last year, four plants were sent to Singapore and on September 15th, at which date our stock had increased to 300 plants of all sizes, 50 were sent to Dr. King at Calcutta, and 50 to Dr. Thwaites in Ceylon, both in charge of Mr Morris. All the stems collected by Mr. Cross were divided between these two recipients. At the end of the year our stock amounted to about 450 plants.

There will be no difficulty therefore in sending a supply of plants of this species to the Conservator of Forests in Madras in accordance with the wish of the Government of India. It will, however, probably be most convenient to treat Calcutta as the depôt for the Ceara rubber plants, as Ceylon must be for Heveas and Castilloas.

With respect to plants of the Copaiba Balsam, nothing can be done. From the five (5) seeds brought to Kew by Mr. Cross, November 21st,

TO AVOID FEVER

Do not drink ordinary milk which has been proved to contain fever germs in immense quantities, and almost every case has been traced to this source. Buy

FUSSELL'S MILK

(GREEN BUTTERFLY BRAND)

FRESH, FULL CREAM, PURE, STERILIZED.

AS USED ON THE KING'S YACHT.

Sold in Pint Tins and small Travellers' Tins.

Of all Retailers. Wholesale: Miller & Co., Colombo.

FUSSELL & CO., Ltd., 4, Monument Street, London, England.

NINE GOLD MEDALS

1876, only two plants have been raised, and these grew with excessive slowness. Nothing can therefore be done at present in propagating them.

Recapitulating, I have therefore to state that Sir Joseph Hooker is of opinion :—

(1) That it is unnecessary to transmit any more Hevea plants to India, and that application should be made for them to Ceylon when required for experimental cultivation.

(2) That as the stock of Castilloas at Kew increases, further consignments should continue for the present to be made to Ceylon.

(3) That plants of the Ceara rubber may with advantage be forwarded to Madras, but that the principal stock of young plants should be sent to Calcutta from which they can be distributed.

(4) That for the present nothing can be done, as far as Kew is concerned, with the balsam of Copaiba.—I have, etc ,

(Sd.) W. T. Thiselton Dyer.

The Under Secretary of State for India.

Note—1. Mr James Collins, really the first man to bring the plant from the Amazons to Europe, was afterwards Government Economic Botanist at Singapore. He only remained about a year, and retired. He was the author of a report, apparently the first real account, of the rubber industry in South America (Report on the caoutchouc of commerce by James Collins 1872).

He described and figured the herringbone system of tapping, and invented several forms of tapping knives, among which is the well-known "Farrier's knife" which was also suggested by Mr Mann, and was used for marking timber in Hanover at that time. He suggested the use of iron vessels for catching the latex in place of the folded leaves plastered to the trunk with clay or calabashes. Clay, he says, contaminates the milk in a very objectionable manner. Yet this system was the only one in Ceylon till 1899, with a coconut shell substitute for the calabash.

2. Plants were sent to Burma, Mauritius and Calcutta, besides Ceylon and Singapore. The plant has always failed in Calcutta, but neither Mauritius nor Burma seems to have taken any trouble to continue its cultivation. In fact, though later the plant was sent to all the other tropical gardens of the Empire, Ceylon and Singapore alone saw the importance of continuing to propagate it so that, thanks to Thwaites and Trimen, Murton and Cantley, there was a sufficient stock of plants and seeds to start the industry when the demand for cultivated rubber sprang up. But though there were upwards of 2,000 Para rubber plants sent to Ceylon in 1877, there seem to have been in 1899 only about 70 trees in the Heneratgoda and Peradeniya Gardens, while in Singapore, which received 22 plants in 1877 there were over a

thousand full-grown trees and from the plants taken up to Perak by Murton some hundreds at least at Kuala Kangsar and Taiping Gardens, were ready as stock for the expected demand.

3. It is interesting to note that Singapore had the first Ceara rubber plants in the East. —Ed.

Colonial Secretary's Office,
Singapore, September 6th, 1878.

Col. Sec. No. 4072-78.

Sir,—I am directed to transmit to you for your information a copy of a letter from H.B.M's Resident at Perak upon the subject of the progress and state of the plants of American Rubbers which were sent to Perak from the Botanic Gardens.—I have the honour to be, Sir, your obedient servant,

(Sgd) J. A. Swettenham,
Assistant Col. Secretary, S.S.

The Superintendent,
Botanic Gardens, Singapore.

Residency, Kwala Kangasar,
26th July, 1878.

No. 202/78.

Sir,—In reply to your letter No. 3590 of the 20th July, 1878, requiring a report on the progress and state of the plants of American rubbers which were sent to Perak from the Botanic Gardens, I have the honour to state that the only plants of this description within my knowledge are one plant of what I suppose to be the Hevea and nine of the Manihots.

These were brought here by Mr Murton in October last and planted at the back of the Residency and are growing very well.

They were quite small when they arrived here, but the first is about 5 feet high with branches of equal length and the Manihots vary from four to eight feet and are growing vigorously.

I believe Mr Murton left plants of some kind at Durian Sabatang and at Thaiping or Matang and I will send on your letter to those places in order that if this were the case some report of their condition may be obtained, but I did not see anything of them in either place on my last visits there, though I carefully inspected the African Coffee, Cloves, Chinese fruits and Australian plants growing on the Residency hill at Thaiping.

There are many Districts in Perak which would, judging from what I have read of the Hevea habitat, be very suitable to the cultivation of these plants, this hill on which they are now growing well is of river gravel and I have no doubt they would have been much stronger in alluvial soil.—I have the honour to be, Sir, your obedient servant,

(Sgd.) Hugh Low,
Resident.

The Hon'ble
The Colonial Secretary, S.S., Singapore.

From this letter it will be seen that Sir Hugh Low was not the introducer of the Para Rubber plant to Perak, but that the plants were brought to Perak by Mr Murton. This has been proved by other letters in an early number of the Bulletin, but the error still frequently appears in various publications. It was probably started by a rather misleading statement in Mr Wray's Memorandum published in 1897 which begins: "The first seed of the Para rubber (*Hevea Braziliensis*) was introduced into Perak in the year 1882 by Sir Hugh Low, the then British Resident. It was sent to me to plant but did not germinate having been kept too long after picking. A second lot was received a short time after and was planted at Kuala Kangsar." These were from the Botanic Gardens, Singapore, where trees began to fruit in 1882—Ed.

Chronological Table of the Para Rubber Industry from 1873 to 1899

1873.........Seeds received at Kew from Mr Collins.

1876.........Seeds received from Mr Wickham. First plants arrived in Ceylon.

1877 June. First plants received alive at Singapore.

Oct. Mr Murton plants the first three in Perak.

1881.........Trees first fruited in Singapore.

1882.........Seeds sent to Kuala Kangsar, and planted by Mr Wray. First seed also sent to Sarawak from Singapore.

1884.........Dr. Trimen commenced to tap the trees in Ceylon.

1885 (circ) First fruiting of Ceylon trees.

1889.........Trees first tapped in Singapore, tins used for catching latex.

1890.........First biscuits exhibited at a Horticultural Show, Singapore.

1891.........Rubber sent to Messrs Silver from Singapore Gardens pronounced of very good quality.

1892.........Dr. Trimen sends to Kew 2 lb. of Rubber grown at Heneratgoda.

1893.........Rubber plants and seeds distributed to all District Officers and Residents in the Federated Malay States to plant near their houses from Botanic Gardens Singapore, (Plants had been distributed to planters for some years previously).

1895.........Mr Kynders1ey starts the first practical Estate in the Federated Malay States.

1896.........Dr. Willis arrives in Ceylon.
Rubber block and biscuit sent home from the Gardens valued at 2/8.

1897.........Mr Derry sends rubber from Perak valued at 2/8 to 3s per pound.

1898.........Mr Curtis sends rubber from Penang valued at 3/4 per lb.
Mr Tan Chay Yan exhibits plantation grown rubber at Malacca Exhibition.

1899.........Mr Derry sends rubber from Perak sold in England for £61—1—6 (3/10 per lb) sheet.

1899 June Messrs Parkin and Willis publish the discovery of wound response and the method of collecting latex in tins.

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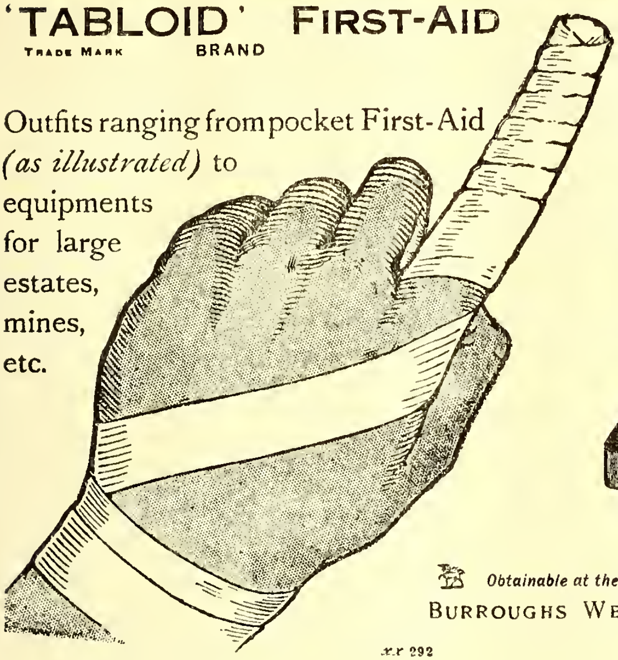

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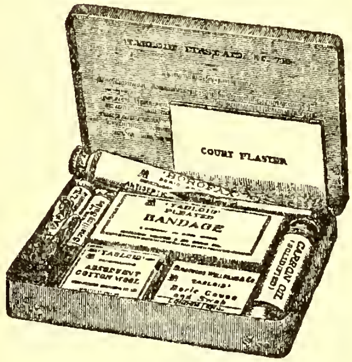

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[We learn that a well-known planter (still in Ceylon) was in 1893 in charge of 'Gangwarily' estate in Western Dolosbage for our old friend the late Mr. John Drummond, and collected that year a great deal of ripe Para Rubber seed which was sold and sent to the Federated Malay States, chiefly Perak. So little was thought of the rubber product then that, about the same time, or a little later, some appreciable extent under Ceara was uprooted to make room for tea. Indeed, another Dolosbage planter, close by, was in the habit of collecting (tapping) rubber from trees on his tottam, until he had got a big "lump" put together and time after time, these samples were sent to Colombo, with no further acknowledgment than "Of no marketable value"—so little was known then of the source of wealth hidden in Para and Ceara Rubber trees! Some of the Gangwarily Para trees of 1893 (if to the fore) ought to be at least 22 or 23 years and giants and valuable now?—J. F.]

CIRCUMVENTING THE WHITE ANT.

The damage done by white ants in India every year must run into tens of lakhs of rupees besides involving an appalling amount of trouble and inconvenience besides. This sort of thing has been going on, one may suppose, since India has been India; and, notwithstanding the gigantic loss occasioned, the white ant still holds the field against all its enemies—man included. No one has yet been able to evolve a specific for the white ant pest that is applicable under all conditions, yet there must be a lot of money waiting for the inventor of such a specific. It is not merely in the destruction of wood that the white ant causes heavy loss, for its depredations are probably greater amongst field crops of a certain kind. As an example, it may be noted that the recent experiments of the Government of the Punjab to grow cassava (tapioca) as a famine crop were largely frustrated in almost every district by the ravages of white ants. In Australia very much the same trouble is experienced in farm operations, but the Australian white ant has a decided weakness for young fruit trees, a failing that has led to an important discovery, which should have its value in India. Mr. W. W. Froggatt, Government Entomologist, New South Wales, has found that German potash (kainit) 'will drive white ants out of any soil where it is used as a manure." In the matter of fruit tree planting, he adds, a pound or so of kainit mixed with the soil when planting should be sufficient for each tree. In India chemical manure is practically never used for field crops; though, if it were, it is admitted that the yield would be increased in value far beyond the cost of the manure employed. The stock excuse is that the ryot is too poor to purchase manure, but if the manure to be employed will not only increase his crops but rid him of one of his worst enemies, would it not be an advantage to the country if the various Agricultural Departments, stepped in and helped the ryot to help himself?—*Pioneer*.

ANOTHER WHITE ANT ON NEW RUBBER CLEARINGS.

Important Note by Mr. Lewton Brain.

Some cases have recently been brought to the notice of the Department of Agriculture, F.M.S., Kuala Lumpur, in which *Termes carbonarius* has been found killing newly planted stumps by stripping them of their bark.

Up to the present this has only been noticed on old tapioca estates.

These termites were previously considered harmless and it is important to find out as soon as possible how far their ravages have been noticed elsewhere.

Termes carbonarius may be distinguished from other "White Ants" or Termites, as they are more correctly called, by the large size and sooty colouring of the soldiers.

The soldiers of this species are of two kinds; the larger over half-an-inch long including the mandibles or nippers, which can inflict an unpleasant bite; the smaller, about ⅜ of an inch.

The mandibles are curved upwards to the tips and do not possess teeth between the base and the tip.

The queen is as large as that of *Termes Malayanus*, attaining a length of one-and-three-quarter inches. These termites are often found in the same nest as *Termes sulphureus*, the little sulphur yellow species, which lives in hard cased mounds sometimes five feet high. The queen of *T. sulphureus* average only one-and-a-quarter-inch in length.

Termes sulphureus and *carbonarius* are both described in books as harmless being fungus (or "mould") eaters. The fungus grows on cakes or masses of vegetable matter which are stored in special chambers in the nest.

Up to now analyses of these masses have failed to show any traces of rubber, but further samples are wanted for analysis with notes of the depth at which they are found, as those examined may only have been collected by *Termes sulphureus*.

If *Termes carbonarius* makes a separate nest, it has not yet been described.

The stumps are reported to be attacked at night and in the early morning after and during rainy weather,

This would be a dangerous pest to young estates, but for the fact that the nest of *Termes sulphureus*, which it inhabits, is easily found on well weeded estates and the inmates, both *sulphureus* and *carbonarius*, can be easily killed with the fumes of arsenic and sulphur applied through the nozzle of the Universal White Ant Exterminator.

Or carbon bisulphide may be poured on to a large piece of cotton wool placed in one of the upper chambers of the nest and the hole above stopped with clay. The vapour of carbon bisulphide being heavy and very poisonous, sinks along the passages, killing all insects with which it comes in contact.

A third improved method would be to find and destroy the queen and then poison the rest of the inmates of the nest.

Specimens of the various forms of this Termite, preserved in spirit, and the queen chamber in the nest, as well as information about the nesting habits, distribution and damage caused, will be most welcome if addressed to :—

The Director of Agriculture, F.M.S.,
Kuala Lumpur,
Selangor.

—*Grenier's Rubber News*, July 8.

TEA IN NYASALAND.

Mr. Grenenger, a tea and tobacco planter of Nyasaland, has favoured us with a call. He gave a very interesting account of the work that is being done in that distant and secluded part of the Empire. At present there are only two small gardens in bearing under tea, with acreage of under 600 acres some 200 acres of which is 5 year old. The last year's export to London amounted to 35 tons only. Eight other gardens are opening up, and the total acreage will ultimately be 50,000. It cannot be increased owing to the severely localised rainfall. Knowledge of the cultivation and manufacture of Tea, however, is very scanty and to get some idea of the methods employed here is Mr. Grenenger's aim in visiting Ceylon. They have, as yet, no pests among their tea, though *thrips* is in their coffee. Their main products, apart from mealies, are coffee and tobacco, of a very good kind, all well sold to London—1s. 6d. a lb. ruling price. The refuse is made into cigarettes locally.

PLANT-FOOD AND ITS PRESERVATION.

Attention is invited to the following interesting and valuable article on farm-yard manure, and its preservation, issued by the Madras Agricultural Department as a leaflet. The information given will be found of particular value to farmers and planters in Ceylon, where, so far at least as indigenous cultivation is concerned, there is a great waste of valuable plant-food readily available. In Ceylon too, as in South India, the soils are thin, lacking a just proportion of organic matter, with the result that it is difficult to maintain properly the fertility of the soil, unless the lacking ingredient be supplied periodically in addition to the usual plant foods. Of the "bulky organic manures" necessary, farm yard manure is the first and best, as well as the most commonly available. Even better than farm yard manure is indigo refuse—seeth—which will become more commonly available in the near future, but which is not now to be had. Even then there will be nothing so generally available as farm yard manure for fattening our thin soils. Every farm, every village, will have abundance, if the cattle byres are properly managed, and the golden dirt preserved as it ought to be, in box and pit, instead of being wasted or, at most just heaped up, and half its value lost. How the best virtues of this manure can be preserved is shown clearly in the extract which we recommend to our readers.

The following is the leaflet referred to above which has just been issued by the Madras Agricultural Department :—

Most of the soils of South India are deficient in organic matter and if the fertility of these soils is to be properly maintained, it becomes necessary to supply this ingredient periodically in addition to the usual plant foods. The manures most suited for this purpose are those classed as "bulky organic manures" and of these Farm-yard manure stands pre-eminent and its use can be confidently recommended wherever it is available.

Farm-yard manure may be used in the fresh state, *i.e.*, as voided by the cattle, but this course is not practicable when the land is under crops and, in addition, it is advisable to use manure which has been stored for some time as, by this storage, not only is a more uniform manure obtained, but the plant foods contained in the dung are brought into a state to be easily assimilated by the crop. During the period of storage many changes take place in the composition of the manure, brought about by bacteria and other low forms of vegetable life, which bring the manurial ingredients into a soluble form. These changes, although making the manure more valuable to the cultivator, are always accompanied by more or less loss of the manurial ingredients and consequently the system of storage which reduces these losses to a minimum is, from this point of view, the one to be adopted.

The main losses which occur during the storage of Farm-yard manure are due (1) to the liquid portion draining away and carrying with it the soluble constituents, (2) to loss of nitrogen in the form of easily vapourised substances and all systems of storage to be economically sound must be based upon principles which tend to counteract these losses without at the same time unduly interfering with the course of the fermentation of the manure.

Whatever the system finally adopted, it is of the utmost importance to prevent the urine draining away as this constituent of farmyard manure contains a very large proportion of manurial ingredients. This can be overcome to a large extent by the use of a suitable litter material which will absorb the urine and so prevent its loss by drainage. The best litter and one which is generally available is the waste fodder of the animals, but leaves, weeds and the ordinary waste of a farm answer well and if these be not available recourse may be had to ordinary soil. The necessity for using ample and suitable litter being apparent for all systems, the different methods of storage may now be briefly reviewed.

The chief methods adopted for the storage of manure may be designated as the Box, Pit and Heap systems and this classification covers in a broad sense all the methods generally adopted. In the Box system, the animals are placed in a loose box, with a thick bed of litter to which the waste fodder is added daily. The dung of the animals is trampled into and intimately mixed with the litter, which also absorbs the urine. In course of time the whole is trampled into a compact mass, and by thus excluding excess of air, the fermentation is kept within bounds. In the Pit system the animals are placed on a hard floor and the dung, urine and waste litter is daily thrown it into a pit dug in the soil of the yard and made as water-tight as possible. Dry earth is sometimes thrown on at intervals in order to absorb excess of liquid and often in very dry weather water is added so as to keep the mass at the requisite degree of moisture. In the Heap system the animals stand on a hard floor and the dung and litter are daily collected and thrown on a heap in the open. Sometimes in this case earth is also added.

RESULTS OF EXPERIMENTS.

These three systems were under trial on the Government Farm at Bellary for many years and the average results obtained may be taken with confidence. These are given *in extenso* in the following table :—

System.		Weight of manure produced by a pair of cattle per annum.	Lb. of nitrogen contained.	Lb. of potash contained.	Lb. of phosphoric acid contained.	Approximate manurial value in rupees,	Lb. of organic matter present.
Box	..	10, 40	90·7	155·3	56·2	69·4	5,020
Pit	..	9,830	55·5	70·0	46·3	37·0	1,765
Heap	..	6,0·0	60·0	59·8	44·5	46·0	2,168

This table shows clearly that, from the same number of cattle, for the same length of time, and under the same conditions, the manure given by the Box system is much greater in amount and contains a greater proportion of all the manurial ingredients, and the value of the manure produced far exceeds that of the others. Compared with the Pit system, the Heap system has given somewhat better results, but this only occurs when the heap is carefully protected from heavy rains and from strong winds. If these precautions are not taken, then the losses caused by the rain washing out the soluble ingredients and the wind removing solid particles can become very serious and considerable loss to the cultivator ensue. Further if the heap is allowed to become too dry, the heat produced by the decomposition may become so great as to cause the destruction of part of the manure.

In the case of the Pit system, the great source of loss is due to the liquid portion of the manure draining away and the use of too small amount of litter. These defects can readily be remedied and when this is done, the Pit system compares very favourably with the Heap method, especially under the usual careless local customs. Wherever the Box system cannot be carried out, choice must be made between the Heap and the Pit systems and this choice must be mainly governed by local conditions.—*M. Mail*, Aug. 8.

THE FUTURE OF THE RUBBER INDUSTRY.

CHANGES ANTICIPATED.

BY HERBERT WRIGHT.

Great Britain leads easily in point of acreage under rubber in its own possessions, and is closely followed by the Dutch East Indies in area, but not in age. The Dutch planters did not take up the cultivation of *Hevea* on a large scale until it had been proved a success on adjacent British territory; and, in fact, much of the area under *Hevea* in Java, Sumatra, and Borneo is owned by companies re-

gistered in England and Scotland. Germany has planted *Hevea* in Samoa and New Guinea, and *Manihot* and *Funtumia* in Africa. During recent times many of the producing or well-advanced estates in German colonies have been taken over by London companies. This is only one of the ways in which the new plantation industry has altered international conditions in the tropics. Great Britain seems likely to increase its control over supplies of rubber in the East, for while it is true that the United States are credited with conspicuous activity today in Sumtara, this country must continue to lead, since it is already in possession, in Ceylon, Malaya, and India alone, of more than half the world's total planted acreage, a good part of which is already producing.

Yielding Capacity of Plantations.

The fact that Ceylon alone produced 1,600 tons of plantation rubber last year, as against 75 tons in 1905, and that the East—mainly Malaya and Ceylon—turned out 1,800, 3,850, and 8,230 tons respectively in the years 1908, 1909, and 1910, point to the likelihood of conspicuous developments in the next three or four years. There are possibilities in the raw rubber industry and the rubber manufacturing trade which very few seem to realise. I have traversed many parts of the East and have spent several years compiling statistics relating to the producing capacity of *Hevea* trees of various ages in the tropics. I believe that in the most favourable parts of Malaya a yield of one ton per five acres will ultimately be annually obtained; in less favoured parts of Java and Ceylon I estimate the yield at one ton per ten acres; for reasonably good estates in Sumatra and South India I anticipate the yield to be between the two estimates here given. In other words, deducting a certain percentage from the world's planted acreage, I estimate that the balance in full bearing will each yield far more than is now annually produced from wild sources. The island of Ceylon alone should, unless some unforeseen disaster overtake it, annually yield from its concentrated 200,000 acres more rubber than is or has ever been yearly obtained from the whole continent of Africa. Furthermore, Malaya and Ceylon alone should within five or six years annually produce more rubber than the whole of Brazil and Central America gave us last year.

Important Changes Imminent.

It should be clear from this that the day is near at hand when the balance of power in the crude rubber market will be considerably changed. Brazil has hitherto had the monopoly and the officials there know how the country has prospered from the revenue from rubber alone. Africa has, unlike Brazil, been largely dependent upon vines as sources of rubber, and the lessened production noticeable, especially during the past few years, is regarded as hopeless. Both Brazil and Africa alike realise that the shadow of huge plantation supplies is upon them, and that sooner or later the abundance of rubber will have its effect on price. Inferior-grade Africans, which make up a good part of that continent's supply, must suffer first; then the better grades from bushes and trees other than *Hevea*, and finally must come a struggle between rubber from the wild and from the cultivated forms of *Hevea*. The supply, in the event of low prices, will be most seriously curtailed from Africa; it will also be evident in tropical America, but not in the same degree. The Brazilian authorities are giving all possible aid and encouragement to those concerned with the collection of rubber in that part of the world, and their country can always be relied upon to give a fair yield. Complete extinction of the wild rubber crops from the forests of Africa or America there cannot be, in virtue of the existence of a population in both areas which must find some means of employment. Yet a curtailment in supplies from wild areas is a certainty, when Eastern plantation crops shall be coming over at the rate of 3,000 tons per month.

Hitherto London has not ranked as of much importance as a centre for rubber, Liverpool having always held the first position. Now a change is already evident. Most of the plantation companies are owned by companies whose interests more or less compel them to sell their produce in Mincing-lane. This business will continue to grow as the yielding capacity of estates increases, while that of Liverpool will, in consequence of lower supplies from Africa and Brazil, tend to lessen. Most London brokers, when asked what prospects they have of dealing monthly with 3,000 tons of plantation rubber, seem disturbed. No time should be lost in preparing the way for the disposal of such quantities, for they will be upon us much earlier than most people imagine.—*Home paper.*

THE GUANO-PALM INDUSTRY IN HONDURAS.

This tree requires a damp marshy soil for its best development, and frequently attains a diameter of more than 2 ft. It is not marketable above that size, however, while the minimum is 8 and 10 inches. It flourishes and is abundant along the lowlands of the coast. The wood in its natural state is exceedingly porous and light, but damp and soggy. To prepare it for commercial use it is put through an evaporating process to extract the moisture, thereby greatly reducing the weight, so that it is not only lighter than ordinary cork, but a given weight is capable of being compressed into much smaller bulk. It is used pulverised and in slabs. Lately the commercial possibilities of the wood have become known, as indicated by advertisements in trade journals offering for sale life-preserving equipments made from guano-palm. Planters in Honduras are awakening to the possibilities of the tree, and one banana grower, who annually clears a large acreage for banana cultivation, is about to send a representative to close a contract with New York importers for a cargo of 150,000 ft. of guano-palm. A recent enquiry from the same market calls for 1,000,000 ft. The greatest drawback to the rapid execution of orders is the difficulty of transportation. —*Royal Society of Arts Journal* for July.

THE INTERNATIONAL RUBBER EXHIBITION.

LECTURES AT THE CONFERENCE.

In connection with the Exhibition, a conference was held. Sir Henry Blake presided, and among those present, were: Professor Wildeman, Dr. Paul Alexander Dr. F Frau, Dr Ernst Stern, Dr. Linding Sachs, Dr. Werner Esch, Dr. J Huber, Mr H Hamel Smith, and Mr A Staines Manders (the manager of the Exhibition.)

Sir Henry Blake—in his opening address—said:—In 1908 it was my pleasant duty, on behalf of myself and the committee, to welcome the foreign delegates and growers to our shores —then strangers; but today, with both hands extended, I welcome old friends, whose presence here today is an assurance in itself that the result of the Exhibition of 1908 has been valuable to every branch of the rubber industry. Of this, if your presence here today were not sufficient proof, there is ample proof in the exhibits shown under our roof from every part—I believe from every rubber-growing country in the world. From abroad we have the machine maker, who has sent his improved machinery, and the chemist, who has illustrated the results of his investigations in the analysis of rubber, and the manufacturer has shown us the improvement in and expansion of new uses for the raw product. When we last met I think the area under rubber in the Middle East alone was about 450,000 acres. Today that acreage has been more than doubled; and in South America and Central America, East and West Africa, the increase in the acreage has probably been in about the same proportion. However, when considering this question of the large increase of acreage, in respect of the possible output of rubber in the near future, I think we must make considerable deductions for plantations possibly established under unfavourable conditions of soil or climate or situation, as experience will show. But I think, on the whole, we must remember that the Para trees planted since 1908 cannot begin to show the results of their planting before 1913 at the earliest, and we must wait a couple of years longer before we know the result of that large investment in new plantations. In the meantime the continued experiments, and the experience of last three years, cannot but be beneficial to these new plantations.

I may say generally that in the Near East the planter has rather affected—almost exclusively affected—the Hevea Brasiliensis, or the Para tree; but, if my information be correct, the sometimes despised Ceara tree is about to come into favour. I have heard on reliable authority, from a gentleman in the Exhibition, of at least one Ceara plantation which has begun to yield its harvest two years after planting. Of course, that would make a very profound difference in the consideration of planting in certain countries where the Hevea has not been particularly successful up to the present. These matters as regards Ceara and Hevea are really matters for the experimenter—the bronzed experimenter in the field—who faces the discomforts and diseases incidental to tropical work in the field and jungle. But, as we know, he only starts the quarry. When we have the latex it goes to the chemist, who tortures it through various retorts, until he has obtained an answer to his questions as to its likes and dislikes, its attraction and repulsion, and as to the reasons of its resilience and strength. We know that some of them—have thrown aside the latex, flung it aside, and, inspired by a wild fury of investigation, have dragged the very vitals from the secrets of Nature, and have presented this Exhibition with a row of bottles and a small sheet of synthetic rubber. Well, this is rather startling at first; but, after all, when we consider that if one of these scientists produced a pint of milk and a pat of butter from a bundle of hay we may be assured of one thing, that the price of hay would go up. We may expect the same as regards the materials of which synthetic rubber is made, so that I do not think it is so disquieting in the end. But one thing it does do—it points to the necessity for strict economy on all our plantations, and for a reduction in the cost of production. Of course, in regard to the Ceara trees there have been great improvements in the tapping—indeed, there have been improvements in the tapping of both, but specially in the case of the Ceara; and, of course, you know the treatment of the tapping of Ceara is quite a different problem from that of Hevea. We do not know up to the present what the effect of that will be.

The President concluded by congratulating those present on the excellence of the Exhibition. These preliminary proceedings were then brought to a close because of the visit of Her Highness Princess Marie Louise of Schleswig-Holstein to the Exhibition. The Princess was escorted around the Exhibition by Sir Henry Blake, and expressed herself highly pleased with her visit. She was accompanied by Lady Blake and Mrs. Hawkes, lady-in-waiting, and was presented with a bouquet by Miss Fulton, the secretary, on entering the Exhibition, and with another, at the Belgian section, by Miss Pollet, daughter of the Consul-General for Belgium.

During the afternoon, Mr. R Fyffe, of the Botanical and Forestry Department at Entebbe, Uganda, read a paper entitled

"RUBBER IN UGANDA,"

and in the course of his remarks said that the first year in which rubber figured as an article of export from Uganda was in 1902, and during that year 68,000 lb. were exported. A study of the composition of the forests of Uganda showed that at least three distinct types existed, in only one of these was Funtumia elastica found. Following the discovery of Funtumia elastica, steps were taken to preserve the trees, and the forests containing it, which were large, were being leased only to responsible companies, who had to observe regulations brought out by the Government for the purpose of conservation. At present the most approved method of tapping was the "herringbone" system. Unlike the Para rubber tree, Funtumia elastica had no wound response and gave the best results, from three to four tappings in a year. The trees could be tapped

from the base to a height of 20 ft. to 30 ft. at one tapping. It is not advisable to tap beyond 30 ft. at one tapping. Trees which were heavily tapped twigs died. Wounds made on the Funtumia tree did not heal up so quickly as did the wounds inflicted on the Para and Ceara rubber trees by tapping. This might be accounted for by the scanty crown of foliage which the former possessed, when compared with the latter species.

On the whole, the yields obtained were very disappointing, experiments proving the yield of mature trees to be about 5 oz. to 6 oz. of dry rubber per year, tapped to a height of 30 ft. The amount of caoutchouc in Funtumia latex was about 0·33 per cent. Funtumia latex coagulated readily by boiling; but the method generally adopted was coagulation by chemicals and hot water in long wooden troughs. Funtumia elastica was an exceedingly slow grower, and he doubted if it was of any importance to Uganda from a plantation point of view. The growth of plants in the forest was very slow, and although they made much more progress in the open, their rate of development was disappointing. Planting on a considerable scale was commenced some three years ago, and the area at present under rubber cultivation was about 3,200 acres. Of this approximately 2,200 were under Para, 9 0 under Ceara and 100 were planted with Funtumia and Castilloa. An estate could be worked so that coffee would form an article of export before the rubber reached a tappable size. Labour was locally abundant, and as transport facilities were improved it would be more plentiful. The Baganda were an easily-taught race, and there would be no difficulty in teaching them to become first-class labourers and tappers. Although Ceara rubber had been grown in the country for ten years, it was only within the last year that it had been recognised as a valuable rubber-yielding tree. The method of tapping adopted was that of pricking, after removing the dry outer bark, and smearing the tree with a coagulant. The "half-herring-bone" system was experimented with, and the results obtained were highly gratifying. The yield of Ceara trees varied remarkably in individual trees. The tree particularly lent itself to speedy results from seed selection, owing to the comparatively early age at which its latex-yielding capacity could be tested. He considered that there was a great feature for Para and Ceara rubber, Para he recommended as a permanent crop, while for a quick return he preferred Ceara.

The conference was resumed on Tuesday. Dr. Torrey presided.

The first paper read was by Dr. Tromp de Haas, the subject being

"TAPPING EXPERIMENTS ON PARA TREES."

In the course of his remarks Dr. Haas described some of the experiments undertaken for the purpose of deciding which was the best method of tapping, daily or every other day. The conclusions he came to were that a larger qantity of rubber was collected by every-day tapping, but experiments would have to be continued before they could get anything like reliable results.

In the course of discussion, Mr. Petch said that from experiments made by Mr. Wright in 1906 and by Messrs Bamber and Lock, which were carried on for two years, more rubber was obtained from every day tapping, but it did not follow that everyday tapping was the best. By tapping every other day more rubber was obtained per day than if they tapped every day, but they did not get twice as much. Tapping on the four years system, they might complete the whole of their bark in two years, and then, presumably, they would have to give the trees two years rest. With alternate-day tapping they would be able to tap during the whole of the four years, and therefore at the end of that time they would take more rubber by alternate-day tapping. It all depended on how long it took to complete one cycle of tapping round the tree.

Mr. MITCHELL—read a paper on

SOME DISEASES OF HEVEA BRASILIENSIS,

in which he stated that the most important disease was fomes. Very few estates in Malaya were free from it, and many had suffered very much. It occurred mostly in trees from one to four years old. It was also to be found in nurseries and in old trees. The physical nature of the soil did not affect it, though loose land allowed the fungus to grow there.

Mr. GUSTAVE VAN DEN KERKHOVE—contributed a paper on

"THE OFFICIAL MEASURES TAKEN : ADULTERATION OF THE INDIGENOUS RUBBERS,"

in which he stated that about 1896 the adulteration of some kinds of Congo rubber, especially the red and black Kasai, had taken dangerous proportions. Out of ten twists three were adulterated and contained a certain quantity of palm kernels and stones. It was absolutely necessary that this evil should be stopped, and the most severe instructions were sent to the producing places, as well as in Europe and America, with the result that the twists were now examined with great care. These wise measures soon showed good results. The same state of things existed in French Guinea in 1897. Competition between the different foreign firms, especially in Conakry, had reached such a degree that the most inferior gums found a buyer at tremendous prices. At the beginning of the year 1901 the French Government decided to prevent the export of the lower qualities of rubber. The interdiction was carefully observed, and no rubber left for Europe without having been submitted to a careful examination, and, considering the tremendous amount of the rubber exports in French Guinea, it was easy to imagine the enormous amount of work required. One kilogramme of rubber was often composed of about ten balls, which all had to be handled separately, so that the authorities had to examine millions of pieces one by one. One of the most dreadful frauds consisted in mixing with the latex mealy or even gummy substances having the appearance of rubber, and without the least commercial value. A simple and practical manner of discovering the said fraud, without recurring to sectioning the balls, consisted in dropping the ball on to the

ground; if the same did not rebound well there was evidently a fraud by means of mealy or gummy products without any value. French and Belgian Congo were tho African colonies which wore the richest as to rubber species, and it was also in those countries that the greatest variety was encountered in the processes of gathering and coagulating the latex.

Growth of Para.

Mr. H. A. Wickham—read a paper on "The Para Rubber Trees in the East," in which he dealt with the danger of too close planting, as tending to arrest growth, impair vitality and set up a struggle for existence which constituted a serious menace for the future. Clean weeding he described as "clean scraping," which exposed the soil to the sun and rain, the latter being carried away. The root system consequently suffered from exposure. Systematised mulching was better than clean weeding. As regarded tapping, he advocated "incision" as against "excision. It was not at all necessary to pare away growing tissue.

In the course of discussion Mr. Bamber—pointed out that, as regarded close planting, they had to look at it from a financial point of view. He was in favour of retaining the soil around the tree.

Mr. Fox—characterised clean weeding as a "fetish," and Mr. Wycherley was in favour of close planting, as he did not think it had the bad effects which were attributed to it.

Mr. Wickham—in his reply—emphasised his previous points.

Dr. E. De Wildeman—read a paper, the subject being

"African rubber vines: their cultivation and working."

In the course of his address Dr. Wilderman said that from the researches of various botanical explorers we knew that numerous rubber-bearing vines or creepers existed in tropical Africa, which vines have for some years supplied almost all the ruhber for the African trade. Their distrihution over the African continent was very wide. Broadly speaking, the ruhher vine area extended from Senegambia and the Upper Nile to the south of Angola, of Rhodesia, and Mozambique, even to the Cape district. Notwithstanding many favourable opinions, the various species of vines, although undoubtedly producers, had neither been cultivated nor worked as they should be. Nearly all the African rubber brought over to Europe, especially from the Congo, had come from wild-growing plants, and very often the native, through an intensive and altogether irrational harvesting, had caused a reduction in the numher of producing plants, if not their disappearance. At first cultivation consisted of seeding in nurseries and setting out the plants afterwards in the woods, or else direct seeding in the woods or in the forest roads. It was soon found that, while vines could be grown from the seed, they attained in the forest insignificant dimensions. To obtain plants as vigorous as the vines worked in the forest by the native, under the conditions there existing, one would have had to wait a considerable number of years.

The result of this was naturally unfavourable to the progress in the cultivation of vinos, their great fault in the eyes of the Government being the slowness of their growth. But one of the conditions of the experiment had not been thought of—the biology of the plant had been altogether overlooked. To allow a plant to develop normally one must give it not only the necessary soluble mineral elements through the soil, it must also ahsorh through its leaves the carhon from the carbonic anhydride contained in the air. What did a plant require to effect this decomposition? Light and chlorophyll. By planting vines under the shado of trees they were placed in very unfavourable conditions for accomplishing this assimilation, because they were deprived of sunlight. The vines now being exploited in the tropical forests had developed very well, because they grew up with the forest, exposing their leaves, flowers, and fruits to the sun together with the trees. Everybody now agreed that the methods of gathering latex used hy the natives of Africa were more or less defective. One seldom saw a case where the native extracted all the rubber contained in the vine. The first method consisted in pulling the vines off their props, to get at them easily. The native then very often spreads the stems more or less parallel to the ground, keeping them a certain distance from the soil by means of supports. Afterwards he made incisions in the stems at regular distances, and gathered up the latex which flowed out.

It was asserted that the greater number, if not all, the plants thus treated died in the underbush, not only because of the unfavourable conditions for vegetation, but also because the wounds caused in the pulling down and tapping would become infected with plant diseases, against which not the slightest precaution had been taken. The reply might be made that the plant would throw out new shoots. That was possible, but they would be few in numher, because the vine would first try to heal its wounds and to fight the microbes that invaded them, and would nearly always exhaust itself in futile efforts. Another method used by the natives consisted in tapping the vines without pulling them down. Cutting constituted the third method, which was a modification of the first one, and was often followed up by threshing. The native pulled the vine off its prop, then instead of tapping it it was cut in pieces, and he gathered the latex which flowed from the ends. This method at first sight looked destructive, but when carefully examined proved to be superior to all others. Indeed, this was the method of the future, but some modifications had to be made to certain details of its application. What now were the objections that could be raised against this method? Only one of importance: The latex did not all flow out of the pieces of the vine; therefore a considerable quantity of the rubber was lost. It had also heen objected that the native killed the vino by this barbarous process.

At the session's opening on Wednesday there was a continuance of the discussion on Mr. Fyffe's paper on

RUBBER PLANTATION IN UGANDA.

Dr. E. Black—said there were two important points arising from Mr. Fyffe's paper—one of which was the distance apart at which trees should be grown, and the other, which was much less known, was the planting of trees producing Manicoba rubber, to only one of which—Ceara—Mr Fyffe had alluded. During five years he had been travelling in all the large rubber-producing countries, and had only just returned from Brazil, and, consequently, he had seen more of rubber-growing probably than any other person. As to the distance at which trees should be planted, two views were taken on the previous day. Mr. Wickham contended that there should be only 40 trees to the acre and Mr. Wycherley contended that there might be 240. The point could be readily disposed of. The man who planted any other kind of tree as close together in proportion to what he hoped to get as the rubber planter did would be quickly classed as a lunatic. The experience of the world since the days of Noah with regard to trees from which fruit was to be obtained was that the trees must be planted a definite distance apart, in order to prevent trouble arising from the roots interlocking. The reason why this trouble had not arisen yet was because of the slow growth of the trees; but it was coming, because rubber-growers were setting at defiance the experience of the growers of other trees in the world, and it was impossible that could go on. The second point was of great importance. He had photographs of Ceara trees in Brazil showing fine growth, but the latex given was practically *nil*. One huge tree, eight years old, gave only 20 grammes of dry rubber—absolutely disastrous. This was due to the trees being taken from its natural surroundings. The result was they got a good garden, but little rubber.

Dr. Christie—said he was one of the lunatics who advocated close planting as regarded Funtumia, but he did not advocate it for Hevea. It was necessary to grow Funtumia closely. It could not be grown unless planted closely, because otherwise they would not get a tapping stem. The tree had the peculiarity of pruning itself; but it could not bring this peculiarity into play unless it was planted closely. Uganda had suffered from a plethora of knowledge of the habits of trees in the forest, without any knowledge of the possibilities of plantation trees. In West Africa thousands of acres were planted with Funtumia without any knowledge of the growth of the tree in the forest. If they studied the growth of the tree in the forest, they would see that it must be planted closely. It was a tree entirely different in its habits to Hevea; it was a deep-rooted tree; it had not big surface roots, and was a tall pole tree with a bold head. It was only possible to get the necessary tall stem by coppicing. The reason why they must have a tall pole was because they could not tap it to the bottom, as they did Hevea. They had to tap to a considerable height, because they could only tap the tree three times in the year; the structure of the bark of the two trees was entirely different, and the trees had to be tapped in a different way. Hevea had a network of lactiferous tissue, whereas in Funtumia they had an upright, parallel system of ducts, which had no connection with each other; and if they attempted to tap the Funtumia as they would the Hevea there would be a "die-back" of the part, followed by the death of the tree. He denied Mr. Fyffe's statement that the Funtumia was a slow grower; it was only a slow grower in the forest. It was the second most rapid grower, Cerea being the first. There was no doubt that Funtumia had suffered from the wrong kind of tapping being practised. He had come to the conclusion that it should be tapped by the incision method, and not the excision. If they took out the bark the tree would die back. It must be tapped by making clean incisions.

Mr. Fyffe—adhered to his statement that Funtumia was a slow grower in the forests of Uganda, where alone he was acquainted with it. He agreed with Dr. Christie as to tapping, and believed that the best thing to use was a pricker.

Mr. Petch—said that in Ceylon they could grow Ceara like a weed, but they could not tap it, though there were some estates getting good results from Ceara. They tapped their trees by all kinds of systems, but they did not mind if the tree died as the result, because they had others coming along and plenty of land. From his own experiments he had not been able to get a tapping system in Ceylon for Ceara without killing the tree. The rubber was in the tree undoubtedly. Up to the present the Ceylon botanical department had not seen sufficient evidence which would warrant them in recommending any of the new manihots to the planter in Ceylon.

Mr. Wilhelm Pahl, of Dortmund, read a paper on

"THE DISCOVERY OF THE PARA REAGENT."

He said:—The victory of cultivated Hevea rubber over natural Para rubber has at last been secured! The mystery of Para rubber is resolved. The really significant agent in Para coagulation is brought to light, and we are at last in a position to replace the primitive Para coagulation methods by an ideal factory method! Chemistry has led on to this victory, torn asunder the veil, and opened up a wealth of possibilities to Hevea planters and to the whole rubber world as well. The reagent that has made all this possible is carbonic acid, and the advantage possessed by planted Hevea rubber over Para will be clear to anyone who studies the two methods and balances their advantages against each other. The new product combines all the good points of plantation Hevea and Brazilian Para, and it shall accordingly be called Hevea Para. For many years chemists have striven to find what was the particular agent to which the marvellous results obtained in Para coagulation (by the smoking process) were due. Scientists from the greatest of the civilised nations have bent themselves to this problem. In 1910 no less persons than Drs. Frank and Markwald, of the Dr. Rob. Henriquez Nachfolger Laboratory, busied themselves with this question. With infinite pains they obtained Urikuri palm nuts, such as are used in the forests for smoking Para, and subjected them to a rigorous chemical examination. They found many things, but, unfortunately, they did not discover the right one.

Among the valuable characteristics of this product (designated Hevea Para) are the following:—The carbonic acid coagulates the latex instantly. The nerve, strength and elasticity are not only equal to but superior to what is met with in case of Para. The metallic salts present are carbonates, as a result of the carbonic acid treatment. The rubber is alkaline, for carbonic acid is not destroyed by alkali, but can exist in contact with it, vide the well-known alkaline carbonic acid charged mineral waters. The solutions of this rubber have as high viscosity as those of Para, and the product obtained on vulcanisation is the same. Carbonic acid coagulation is the cleanest possible method, and gives the purest and lightest coloured product possible. On the other hand, Para rubber is coloured by the smoking process. Hevea Para never moulds, for the carbonic acid removes the plant-albuminoids which form a soil for bacterial vegetation. Hevea Para oxidises no more readily than does Brazilian Para. Rubber coagulated by acetic acid soon acquires a bluish surface colour. This is due to the decomposition of residual albuminoids with formation of phenols, which give the rubber its bluish colour, and make it second quality. In the new process we have for the first time a latex coagulated by a gas, and not by a corrosive fluid, as in case of the strong acids. Briefly, we have here the only re-agent which can give planation Hevea rubber the same fine quality as Brazilian Para. Another advantage of carbonic acid is that it requires no fine manipulation. Its use can be entrusted to the most ignorant hands.

Mr Petch—denied that it was possible for any coagulum to prevent mould.

The second longest discussion of the day was raised by this paper which was very severely handled by several of the English experts. Professor Carmody said they were always ready to hear of any new coagulum, but he did not think the lecturer had made out his case altogether satisfactorily.—Dr. Stevens traversed the paper from end to end, pointing out that most of the statements were contentious statements. At the same time he thought it might be worth while to make a trial with carbonic acid. The arguments used had not inspired much confidence in the theory.—Dr Huber objected to the title "Hevea-Para,"as Para they understood to be rubber from Hevea.

The afternoon was devoted to a joint meeting of planters, manufacturers, and chemists, and under the chairmanship of Dr. Torrey they discussed the question whether it was not possible for the planter to devise certain tests by which they could ensure

THE STANDARDISING OF THEIR RUBBER.

The Chairman, in opening the discussion, urged that this was a matter of special importance to the planter. Immediately two planters arose and said it was impossible for planters to undertake tests on the field, and that they, on their part, wanted to know what it was the manufacturers required and then they would endeavour to supply it.

Dr Huber—said that though not a planter by profession, he had planted rubber trees in the experimental gardens at Para, and he had done a good deal in the way of testing samples of rubber. He thought it would be possible for the planter to get good relative results which would be sufficient for the purpose, and he indicated several ways in which it could be done.

Mr J Ryan—a planter—thought these suggested methods would be impracticable.—Mr Potts said the problem for the planter was not so much to determine quality as to make from the beginning careful tests of the latex, in order to get absolutely uniform results.—The Chairman agreed with this, and said that what was wanted was not for the planter to distinguish qualities, but to ensure that the quality of a given kind should be permanent and reliable in subsequent supplies.—Mr Francis Martin, as a manufacturing chemist, thought it possible something could be done.

Professor Calmody—of Trinidad—said that as regarded Castilloa they got uniform results in the preparation of rubber by a centrifugal machine invented by Mr Smith, of Tobago, and an excellent quality was turned out.

Mr Harvey—of South Mexico—spoke of the juice of a plant found there which was used in coagulation. He thought chemists might investigate whether a preparation of this could not be used throughout the world At present their preparations would only keep a very short time. He also urged that it was not so much a question for the planter as for the manufacturer.—Dr. Stevens, on the other hand, thought that simple tests could be used by the planter.—Mr. Gorringe said it would be no good the planters making a test if the brokers in London sold it not by that test, but by feel and sight.

The Chairman—in concluding the conference on the subject—urged the planters to see what could be done in order to procure that the rubber they supplied should be uniform in quality.

To the exhibit of the Imperial Institute representing the rubber resources of the Empire the British South Africa Company contributes a collection of specimens of the rubber-yielding plants of Northern Rhodesia. These include specimens of Landolphia vines, which are reported to grow luxuriantly in many districts and to cover large areas of the country, and also a number of specimens of various roots from the bark of which root-rubber is prepared. Additional interest is lent to the exhibit by specimens of dried and mounted leaves and flowers of the plants, further illustrated by coloured drawings.

A very interesting and practical demonstration of the process of tapping rubber trees was given on Saturday. The tapping of the trees took place at the joint stand of the Soconusco Rubber Plantations, Limited, and La Zacualpa Plantations Company, Limited, situated in King George's Hall, where specimens of eight live Castilloa lactiflua rubber trees from six to ten years of age from the estates were exhibited. The foliage of the trees had been cut away, and also the whole of the roots, with the exception of about 1 ft. measured from the bottom of the trunks. In spite of

the trees having travelled about 800 miles by rail and from 3,000 to 4,000 miles on the deck of a steamship, they arrived in excellent condition; for no sooner had the tapping knife made the necessary V-shaped incisions than the latex flowed freely. The latex so obtained was afterwards coagulated in a centrifugal machine.—*H. & C. Mail*, July 7.

At the conference, which was continued on 6th inst., at the Rubber Exhibition, under the presidency of Dr. Torrey, the first paper read was a highly technical essay by Professor SCHIDROWITZ on

"VISCOSITY OF RUBBER SOLUTIONS."

He said he had studied for two years the effect of various factors on viscosity, the effect of heating in solution, which did not always cause disaggregation. On the contrary, in the case of old forest tree rubber the aggregation appeared to increase. In the case of young or immature trees also it appeared to decrease. Then he studied the effect of deresination, and here again it was found that in the case of old forest trees the result was positive—that was, that the viscosity increased. Then he studied the effect of the method of coagulation on a number of samples, and found, as he expected, that he got very high variations by the viscosity method.

A long discussion followed, the most popular point raised being whether these tests would be useful to the planter on the estate. Professor Schidrowitz said that where the planter was in a position to carry out viscosity tests on scientific lines, it might be useful to him in controlling the quality of his rubber. But he wished it clearly to be understood that he did not prefer the viscosity method to the vulcanisation method. The vulcanisation method was preferable where it could be applied, but the viscosity method was useful where it could not.

Dr. HUBER then read a paper on the

RUBBER TREES AND WILD RUBBER RESERVES OF THE AMAZON.

He admitted that interest in the subject was rather discounted by the greater popularity of middle red rubber; but he thought it would interest people to know something about the region which yielded the best kind of wild rubber. He went into the history of wild rubber at length, and dealt with the variations of the various kinds of rubber which had been found in the different parts of the country. Hevea contained some well-defined groups of species which, though in the first line of practical value, were characterised by botanical sub-divisions. By far the greater part of para rubber came from Hevea Brasiliensis, which was not only the best, but the most unknown variety. It grew throughout the whole Amazonian basin, principally in its southern part, where it occupied not only the low alluvial lands of most of the affluents of the Amazon, but some of the higher lands, principally between the River Tapajoz and Madera, and also between the higher course of this river and the upper River Purus and its tributaries, and the Acre and others. It was, however, possible that the trees of the higher land were of a very near but distinct kind of Hevea. It was evident, however, that the seeds obtained by Mr Wickham, who went to the East, were of the true Hevea Brasiliensis. There were particular kinds of Hevea on the Rio Negro whose latex was said to produce good rubber; but on the whole, little was known of the rubber yield of these trees. Of the 12 species of sapium, only one was recognised as producing good rubber. These trees were of rapid growth and the latex was often mixed with Hevea.

The exploitation, however, of these trees was not popular, owing to tapping difficulties. The production of a more suitable tapping knife might lead to its becoming more popular. Very important as a future reserve of wild rubber was the Caoutchouc tree, which was the large virgin tree of the forest, and was rich in caoutchouc. There was an enormous reserve here. The export of caoutchouc had increased from 349 tons to 8,000 tons. So many trees were there that the natives did not trouble to tap the trees in the ordinary way, but cut down the tree bodily. He advocated the making by the Government of "forest reserves" in order to protect these important trees from extinction in this way, because there was undoubtedly a large and valuable reserve here.

Mr. CLAYTON BEADLE, in the next paper, called attention to a new method of

TESTING RUBBER BY USING THE ENERGY OF A FALLING PENDULUM

and noting the distance of the height to which the pendulum rises before and after breaking the specimen, and utilising that in recording the actual amount of work done in breaking the specimen. They did not at present know the value of this. In the Schwartz machine many thousands of determinations had to be made of mixtures of known composition before the result could be properly interpreted. In this case the machine would have to be used on mixtures of known composition, and made under known conditions before they knew the value to be placed on the results and how they were to interpret the figures.

In the afternoon a meeting was held of the India Rubber Testing Committee, Dr. A. H. BERKHOUT, who presided, said that at the meeting held three years ago he was asked to take the initiative in forming this company. The committee had been formed, and had sections in various countries, at the head being Mr Herbert Wright, in London; Professor Dr. Warburg, Berlin; M Pierre Breuil, Paris; Mr C Pearson, New York; Dr. Herbert, Vienna; Mr Kelway Bamber, Ceylon; and M J E Fol, Delft. First, they had to conquer the difficulty of establishing standardising methods. Of course, it was necessary they should understand each other in regard to the physical and chemical proceedings of testing indiarubber. It was too bad that a man should not know the signification of his own figures, and not be able to understand someone else's. What they wanted was a uniform standard for testing rubber. This standard should be beneficial to rubber manufacturing and the cultivation of rubber.

The secretaries of the various national branches then reported on the steps taken in their respective countries to start the work of the association.

It was announced that Professor Huber had undertaken to form a branch in Brazil. He addressed the meeting, and urged that the Governments of all countries should take steps to see that rubber sent out under a well-known name was really rubber of that kind, and not a mixture or a substitute. Governments should see that it was properly stated where the rubber came from and from what tree. He knew of cases where rubber was supplied under a well-known name which was of a different make and from a different tree. He also advocated the forming of museums of standard qualities and kinds of rubber.

The conference was resumed on Friday. Dr. Torrey presided.

Dr. W Carnegie Brown, M.D., M.R.C.P., read a paper on

HYGIENIC CONDITIONS AND THE MAINTENANCE OF HEALTH ON RUBBER PLANTATIONS."

In the course of his address he said that the development of the industry had led to a huge demand for labour, and the influx of coolies had naturally led to remarkable facilities for the spread of disease. A large number of Europeans had gone to make their homes in the tropics. Apart from the fact that the indigenous populations were deeply affected, many of the labourers, and especially their children, though showing no signs of illness, harboured the germs of malaria and other parasitic disorders, and were consequently a readily available source of contagion, of which the most frequent victims were the other immigrants, and especially the highly-susceptible new arrivals from Egypt. There was, therefore, little cause for surprise that serious outbreaks of tropical disease were not unusual. During the last two or three years no question had been so frequently asked him as "Is the climate very deadly?" No doubt, most of the estates were naturally insalubrious, but the causes of tropical disease were now so well known that almost compete prevention was by no means difficult. The drainage and cultivation necessary for the successful production of rubber were powerful aids to sanitation, and on a well-managed estate there should be no epidemics and very little serious illness. Intelligence and constant vigilance were required, but, given these essentials, the death-rate should be scarcely higher than in Europe, and with care in eating, drinking, and other matters, an assistant should be as healthy as on any farm in Yorkshire. But he must be a picked man, of good physique, not big or fleshy, with a good family history; no tendency to alcoholism, insanity, or tubercle, and all organs —especially the heart—sound. Dr. Brown went on to comment in very strong terms on the negligence of the authorities in doing little or nothing to arrest the disease which had grown rapidly of late years in Singapore and other places. In 1892 the death rate at Singapore was 31·27, in 1902 it was 51·11, and according to the latest reports it was worse than ever. Malarial fever was very rife. He compared this with what had been done at Santos and other places. In 1900 the death rate of Santos was 70 per 1,000; in 1903 drainage and sanitary work was undertaken, cleanliness enforced, and a good water supply obtained, with the result that since 1905 there had been no case of yellow fever, and the death rate was down to 22 per 1,000. In Sorocaba yellow fever had been got id of. In Manila the Americans at once undertook to spend £800,000 for waterworks. He also instanced Panama as having been reformed from a deadly, fever-ridden place into one as healthy as Hampstead. It was possible to entirely get rid of malaria, which was spread by mosquitoes, simply by well-understood sanitary precautions. It was only necessary to drain and fill up swamps, keep a sanitary staff to look after the natives, and especially look after the segregation of the sick and particularly of the children. Many of the rubber estates had been made free of malaria, and all of them could be. The same thing applied to anky-lostomes and small-pox.

Dr. Henricksen read a paper on

"THEORY OF VULCANISATION,"

a subject about which much was heard some ten years ago, but which came to more or less of a standstill. Nothing had been said on it for a long time that was of much consequence, until two or three years ago, when there was a renewal of research and literature on the subject, with the result that an entirely new aspect had been given to the matter. There were, he said, two proposed theories for explaining the phenomena of vulcanisation—one chemical and the other physical. The newer, or physical, theory had been advocated specially by Dr. Ostwald who held that the taking up of the sulphur, or protochlorides of sulphur, by the rubber was exclusively a surface action, or absorption, The older chemical theory was that the changes that took place in vulcanisation were associated with the formation of a series of definite compounds of rubber, with sulphur or protochloride of rubber. Experimental evidence had been offered in support of each. Dr. Henricksen reviewed all these experiments, and concluded by saying that physico-chemical methods, and, especially the laws of reaction, kinetics were able to offer fruitful suggestions for a systematic and scientific investigation of vulcanisation phenomena, as well as for practice.

Later in the day an important statement was made by Mr. Clayton Beadle as to the amount of

ACETIC ACID IN PLANTATION RUBBER.

It had been found by testing that the acetic acid used to procure coagulation of the latex on the estates could be practically all washed out, and also that there was in washed plantation rubber less acidity than was found in fine hard Para, the acidity of which was due to the absorption of acetic acid during the smoking process which it underwent.

Mr. Jaques read a paper on the

ADAPTABILITY OF RAW RUBBER FOR MANUFACTURING PURPOSES,

in which he stated that, generally speaking, the physical qualities of vulcanised No. 1 latex compounds were identical with those characteristic of hard-cured Para. The tensile properties of the cultivated rubber were usually equal to or of a slightly lower order than, indigenous Para,

There were well-known smoked and some pale qualities unquestionably of a higher grade than the average hard-cured Para. A disquieting feature with a few cultivated Hevea sorts was the difficulty experienced when breaking down and masticating them. On the hot mixing rolls some of them did not soften readily, and it was in many cases impossible to obtain a calendered sheet worthy of the name and at all suitable for high-class work. Tough raw rubbers having the appearance of possessing plenty of 'nerve' were not necessarily the best for manufacturing purposes. Having said this about the difficulties presented by some Heveas, he proceeded to speak in their favour. There were cultivated Heveas more amenable on the mixing rolls than hard-cured Para, which calendered as well, vulcanised more rapidly, were stronger, and were just as adaptable as the best native rubber. Plantation rubber, under the right conditions, also got strength from maturity. Castilloa, Rambong, Landolphia, Funtumia and Guayule rubbers were softer, and compared unfavourably with Hevea. The highest grade Hevea was pre-eminently the rubber from which to manufacture the first coating for cable wires, threads and surgical goods, on account of its reliability, strength and durability under the very severe trials these articles were subjected to. The manufacturer did not find it profitable to use even lower-grade Hevea for these purposes. On the other hand, he did utilise Castilloa, Rambong, Landolphia, Funtumia and other rubbers for making tobacco pouches and teats; but it was doubtful if even the cleverest manufacturer could make a satisfactory hard-wearing pouch from the highly-resinous Guayule rubber without the addition to it of one or other of the former brands. The best pure rubber articles were those made from Hevea. Motor-tyre treads could be made and were manufactured successfully from the lower-grade Hevea, Castilloa and similar brands. This part of the tyre contained a good deal of mineral matter, which increased the tensile strength and aided the tread to resist friction. Moreover, the use of the best Hevea, even allowing for the increased strength and durability obtained, would be rather extravagant, as the life of a tyre tread was comparatively short, even when made of the finest material. All classes of raw rubber were used by the solid tyre manufacturer, and it could not be said that if he used the highest-grade Hevea—that was, if the price allowed it—his goods would give greater satisfaction to his customers. Pontinac, when washed, was used without further refining in conjunction with raw rubbers of a higher grade as the base of a compound, which was spread as a solution on to asbestos cloth and papor to be made into steam-packing and so on.

On Saturday, a general discussion was invited, and Dr. HUBER (Brazil) said it would be interesting to know the

OPINION OF MANUFACTURERS ON UNSMOKED PARA

as compared with wild rubber trees.

The CHAIRMAN—said he could give a partial answer. In his experience it had not been an uncommon thing for manufacturers to get a quantity of third grade—what was called Sernamby—which they would sometimes rate as high as the best Para, and would use for the same purposes; but it was a product that would vary enormously, sometimes being extremely good and other times extremely bad. He was inclined to think that, at times, scrap rubber which had not been smoked was every bit as good as smoked.

Dr. HUBER—said there were two kinds of scrap exported from Brazil—the real scrap from the trays or pans, and that which had coagulated naturally in the tins on the trees.

Dr. ESH (Germany)—said the experience in Germany was that the best grades of Sernamby would not give the English cut sheet, or be useful for goods of high quality. The elasticity after being masticated was very low in comparison with the real smoked Para. It was also his experience that for hard cured rubber goods—such as motor tyres—they could not use plantation rubbers. In some cases Sernamby was better than Para.

The CHAIRMAN—said he knew that at least one of the large manufacturers of tyres used large quantities of plantation rubber, and the tyres had a world-wide reputation for wearing quality. The question of the use of plantation rubber was not a matter of touch and go—not a matter of a single experiment that did not happen to turn out well. He agreed that some kinds of plantation rubber did not resolve so well, milled under the same conditions, as fine Para. That was tempered somewhat by the fact that it was not uncommon to have two classes of plantation rubber—one that masticated well, and one that did not seem to stand milling so well, and yet when they were vulcanised one was as good as the other. He had seen that plenty of times. It was impossible to tell by observation how a piece of rubber was going to vulcanise.

Dr. ESH—said the difficulty with plantation rubber was to get enough of the same kind. One of the biggest German rubber works had said that it was impossible to get English cut sheet from plantation rubber; and that was one of the most important tests. If a rubber would give English cut sheet it was a rubber of fine quality. There were plantation rubbers which stood high mastication; but most of the manufacturers of rubber goods feared there would not be enough of such kinds of plantation rubber. If they bought 10 tons which satisfied them it was difficult to get another 10 tons later of the same quality. At the same time they would be very glad if plantation rubber increased in standard, so as to be thoroughly reliable.

The CHAIRMAN—said it depended a great deal on the methods of the factory. No one was more in favour of plantation rubber than he was; and manufacturers had been able to get along with all grades of rubber of vaying quality, notwithstanding all that was being said about the necessity for uniform plantation rubber.

Mr. F. CROSBIE ROLES (Ceylon)—thought the difference in quality was due to the fact that, in the first instance, old trees were tapped, whereas now young trees were being tapped and young trees did not yield as good latex as the older trees.

Dr. HUBER—remarked that he had gathered from the conference that the superiority of the wild Para was admitted, and that its uniformity was due to the method of preparation. It seemed to be the opinion of chemists and manufacturers that the superiority of wild Para was not in the composition of the latex, but in the mode of preparation and the uniformity of the product. That was very important to the Brazilians.

Mr. SUTER—said there seemed to be considerable variety of opinion as to whether there was a superiority in hard Para over the plantation rubber. Owing to the youth of most of the plantations, there was an insufficient quantity coming from particular estates; but this would be overcome later. It seemed to him that one manufacturer preferred one kind and others preferred different kinds. The planter thought it might prove a matter of fashion. Certainly the manufacturers had given no reasons for the changes they made, and the planter could not tell what to aim at, and therefore simply pleased himself in the matter, and suited his own convenience. It was a young industry, and things would right themselves.

The CHAIRMAN—said remarks had been frequently made about manufacturers telling planters what kind of rubber they wanted, and what was wrong with the kinds they did not like. If they did it would involve no end of trouble. Manufacturers did not trouble themselves about composition; they did not care about the percentage of protein or resin in the rubber; what they did want was that what they got once they should be able to get again They wanted uniformity. It occurred to him that they should follow the example of the creameries, who collected their milk from all sources, and managed to produce a uniform article.

Mr PETCH (Ceylon)—said two points he had gathered from the Conference was that plantation rubber was not as good as it used to be, and that it was not sufficiently uniform. He agreed that the former point was due to the young trees being tapped now. It was undoubted that rubber from old trees was better than from young ones. He could not understand why the rubber now coming in was not of uniform quality, as the bulk was from trees of the same age. As to the Chairman's suggestion that they should bulk the latex like the creameries did their milk, they had always been told that whatever they did they must not mix their latex. The planters would be willing to bulk it, if told to do so, as it would save labour.

Dr. BLACK—said he had satisfied himself, by experiments, that the rubber from young trees was absolutely inferior to that from old trees. He did not agree with the chairman as to mixing the latex.

Mr WHALLEY—remarked on the different meanings of the word 'unformity.' Uniformity to a planter meant the uniformity of the product of his estate and to a manufacturer uniformity in the quality he desired. Yet again it meant that there would not be a greater loss than 10 per cent in washing. There were 5,000 or more manufacturers, and it was impossible to get them to give a standard definition.

On Wednesday, Mr KELWAY BAMBER, of Ceylon read a paper on the

"GROWTH AND PRODUCTION OF PLANTATION RUBBER,"

in the course of which he said there had been no great change in the methods of planting Hevea rubber since the previous exhibition, and although a good deal had been said of late of wider planting, the average number of trees per acre might still be taken at about 150, obtained by planting 12 by 24 or 15 by 20. In Ceylon this did not appear to check development for the first few years, and gave a more rapid protection of the surface soil from the sun's rays and direct rainfall. Wider planting, with from 40 to 48 trees per acre, would no doubt give, in time, larger and more productive trees, capable of renewing bark freely; but up to the present the closer-planting method had been more remunerative, and for those countries now planting Hevea it would still be the wiser policy to plant at least 100 trees per acre. When rubber first began to be planted on a large scale it was usually estimated that no returns would be obtained under five or six years, but it had been found in many instances that the trees were of sufficient girth to commence tapping in or after the fourth year, and that with careful work no harm resulted; but should the trees be over-tapped at that age serious harm might follow. The spiral form of tapping had now almost entirely gone out, and latterly also the old system of pricking and paring was disappearing, as it had been found that better yields were obtained by paring only, and with less injury to the trees. The evidence was, however, not inclusive, and some of the finest work had been done by the combined tools, followed by excellent healing of the bark.

They might expect a gradual lengthening of the period of bark renewal after each tapping, but opinions were completely changing as to the actual time required. In order to prevent the interference with circulation which undoubtedly occurred under the ordinary system of tapping, experiments had been conducted at Peradeniya with a new incision method with, so far, very satisfactory results. It consisted in cutting shallow vertical channels down the bark from 6 ft. to the ground, incising these at one foot intervals, and collecting the latex at the base of the trees in the usual way. The method had the objection of increasing the proportion of scrap rubber, but if this was collected at once in buckets of water to protect it from the air, and heated to 180 degrees before rolling, the rubber was as good as that made direct into freight, and if smoked could hardly be distinguished from it. Another point observed was that with the rapid increase in girth of the trees the width of the channels increased in proportion.

Mr WICKHAM—strongly condemned close planting. He agreed with what Mr Bamber had said as regards tapping, and was glad he had come to view the excision method with favour. Personally, he thought the present method of coagulating with acid would have to give way to coagulating by smoke. At present they were curdling the latex and forming rubber trees. The smoke method was that by which the fine hard Para was produced, and it was known that that was always of uniform

quality, the very quality which was absent in plantation rubber. If they wanted uniformity they must try the smoke cure.

Mr Tudhope—advocated the collecting of the latex at central factories, as was done with regard to milk in Denmark. They would have to place in charge of these factories highly-qualified men. They would then produce rubber in tons where at present they were producing it in hundredweights, and the trouble as to uniform quality would be at an end.

The Chairman—said that on the question of uniformity the proposal of Mr Tudhope presented many difficulties which were prevented from being carried out. So far as he could judge, what was likely to happen was that they would have the estate marks for the production of the estates, and the estate managers themselves would be the best judges of what grade they should make their different kinds of rubber. The testing of milk was a very different thing to the testing of latex.

Mr Kelway Bamber—in replying on the discussion, further illustrated his new method of tapping, and said he believed it would prove a success. With regard to uniform quality, he believed it was only a question of time and that the present difficulties would be overcome.—*H. & C. Mail*, July 14.

THE WOOD-ALCOHL INDUSTRY IN GERMANY.

The wood-alcohol industry in Germany made slow progress until 1880, when the law providing for the denaturation of alcohol was passed, but about the same time the importation of wood alcohol and pyrolignite of lime from the United States began, and a number of the wood distilling firms merely bought up these imported raw products and manufactured them into acetic acid, methyl alcohol, and denatured wood alcohol. The largest concerns, however, soon established their own distilling plants in the thickly-wooded surrounding countries of Galicia, Hungary, and Russia, and imported their raw products to their refining plants in Germany. Exact figures of the production of wood alcohol and pyrolignite of lime are not published, but according to a reliable estimate there were produced in a recent year, in Austria-Hungary, and Germany, about 6,500 metric tons of the former and 27,000 to 28,000 metric tons of the latter. The industry has also suffered somewhat of late years on account of the competition with the great volume of denatured potato and grain alcohol produced in Germany. The fact that deciduous varieties of wood are comparatively scarce in Germany is another reason why the wood alcohol industry is not so far advanced. Chemists and distillers state that wood from coniferous trees produces only about one-half the wood alcohol and pyroligneous acid produced by wood from deciduous varieties, and that the profitable distillation in the former case depends upon the quality and quantity of the pine oil and tar obtained. On account of the costliness and general application of these woods the stumps of coniferous trees are practically all that are distilled. The distillation of sawdust and wood refuse has not proved profitable, because practically all these products in Germany come from coniferous woods, which not only produce little alcohol and pyroligneous acid, but very little tar and pine oil. The charcoal obtained in the distillation of sawdust, which is the only other product of possible commercial worth, is comparatively valueless, because it is in powder form, and efforts to obtain it in briquette form have as yet proved unsuccessful.—*Royal Society of Arts Journal* for July.

SYNTHETIC RUBBER.

And the Test Committee.

The challenge by Mr Stanes Manders, the organising manager of the Rubber Exhibition, to the Caoutchouc Syndicate to manufacture synthetic rubber under test conditions was, as stated in our issue of Monday, accepted by the syndicate.

The demonstration will take place today. The committee officially suggested to ascertain whether the claims made by the syndicate are capable of satisfactory proof includes Dr Henry P Stevens, M.A., F.I.C., Dr. Philip Schidrowitz, F.C.S., and the Chemical Expert of the *Financier*, Mr Hermann C T Gardner, F.C.S., M.P.S. The operations connected with the manufacture of the substitute will commence this (Wednesday) afternoon at 4 o'clock. A strict watch over the substance will be kept day and night until 4 p.m. Saturday afternoon, when the substitute for natural rubber will be on view and tested in all ways by experts, the tests including the one of vulcanisation.

Our readers may care to hear that the experiment of making 'synthetic' rubber by the formula of the Caoutchouc Syndicate, Limited, to which reference has been made in our news columns as prospective, is now under way. On Wednesday a quantity of the syndicate's isoprene—and something else; what, we do not know—was placed, in the presence of committees of experts and journalists, in an autoclave and there it will remain sealed at the necessary temperature until Saturday afternoon at four o'clock. The receptacle then will be opened in the presence of the committees (having been kept under strict observation by both parties to the experiment to prevent interference by either side), and the resultant mass will be handed over to the inventor of the process for treatment. This it will undergo under the observation of the committee of experts, and at seven o'clock on the same evening it is to be divided up, one portion going to the Silvertown rubber works for vulcanisation and the others being handed over to the investigating experts for testing purposes. As a member of the journalistic committee we cannot indulge in any expression of opinion at the present juncture, but we might just point out that we endorse Sir Henry Blake's remarks prior to the initiation of the experiment that the production of some substance resembling rubber leaves the commercial aspects of the invention still to be considered, and that the real crux of any test lies not in starting off with the isoprene as prepared but in the making of the isoprene.—*Financier*, July 5.